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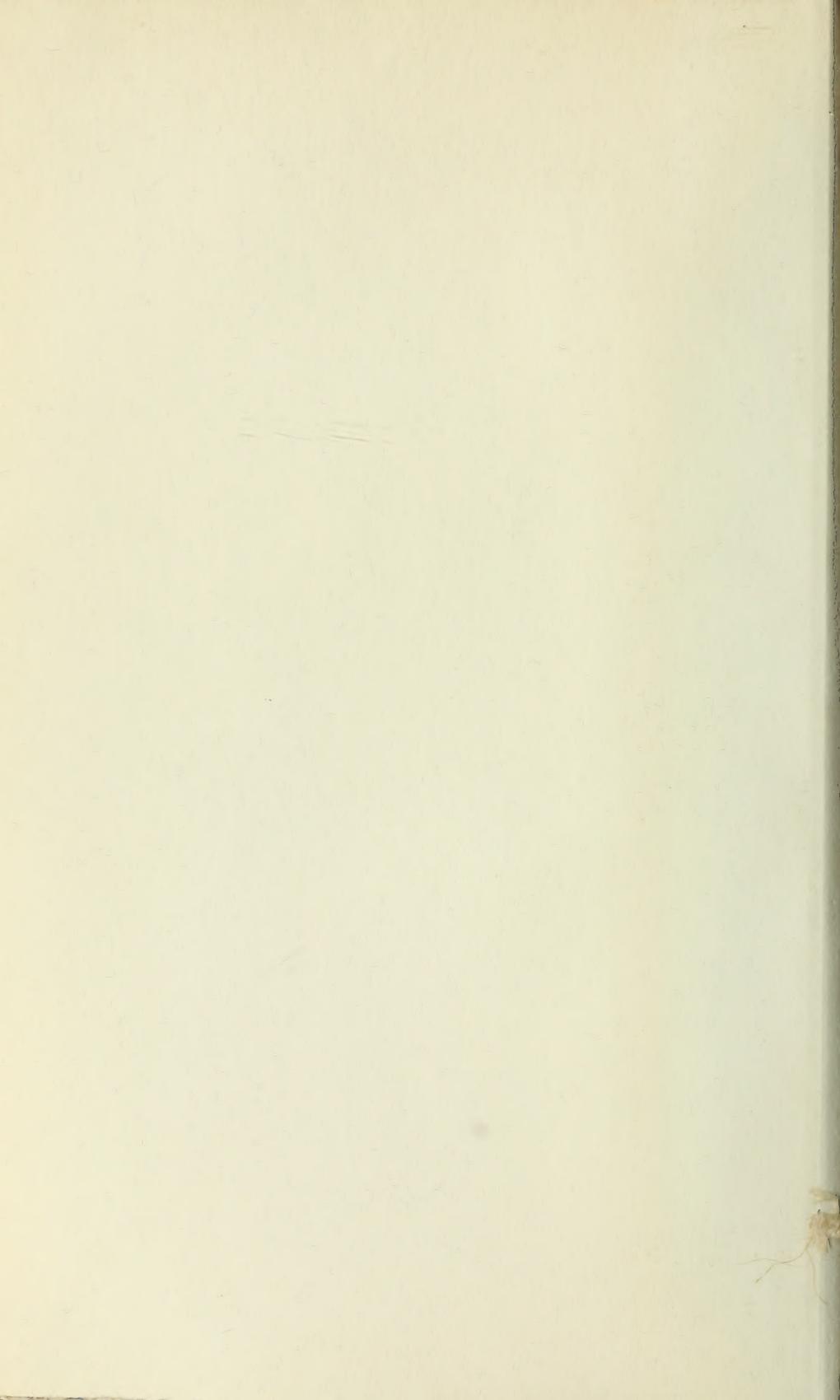
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JOHN M. CLARKE Director

Bulletin 91

ZOOLOGY 12

HIGHER CRUSTACEA
OF
NEW YORK CITY

BY

FREDERICK C. PAULMIER Ph.D.

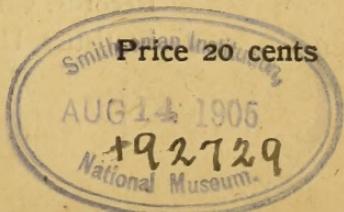
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Bulletin 91

ZOOLOGY 12

HIGHER CRUSTACEA OF NEW YORK CITY

PREFACE

During the last few years the bulletins by Gerrit S. Miller jr., Tarleton H. Bean, Edwin C. Eckel and F. C. Paulmier have given facilities for the identification of the mammals, fish, reptiles and batrachians of the State, and a descriptive catalogue of the birds is already under way. In order to continue this series, Dr Paulmier, Assistant in Zoology, is preparing a catalogue of the Crustacea of New York.

The greater part of the State not having yet been worked over, it seemed best to confine the first list of Crustacea to the fauna of a limited area, and the present city of Greater New York appeared to be one well suited to the purpose, both on account of its varied geographic conditions, and because a large proportion of the people who need to use any but a catalogue of the purely fresh-water or land forms are to be found there.

As the preparation of the complete catalogue will occupy considerable time, it is thought advisable to issue as bulletins, as soon as prepared, the parts dealing with the separate groups. The present part relates to the higher Crustacea.

F. J. H. MERRILL

INTRODUCTION

In these days of nature study in the schools and elsewhere, attention is chiefly paid to a few striking groups, the birds apparently being the forms most favored. Invertebrates with the exception of mollusks and insects, are receiving very little attention, though there is a wealth of material awaiting the patient investigation of their life histories and habits.

One of the evident reasons for this is the lack of facilities for easily identifying the forms collected. The literature of the subject is large, though much of it consists of mere verbal description, and only a part of the species have been figured. Much of it too, is usually inaccessible except to those within reach of large libraries.

The group of which the present catalogue treats, the malacostracous Crustacea, perhaps suffers less from this deficiency than some others, for many of the forms are large and conspicuous and have been frequently brought to public notice. It is true also that keys to the greater part of this group have been recently published, but it is the belief of the writer that, even with the best of keys, the inexperienced observer has difficulty in identifying members of large groups without the aid of illustration.

It is with the hope of partly remedying this deficiency that this catalogue has been prepared, and figures of all the species taken within the city limits are here given. It is not complete; the collecting has not yet been extensive enough to include all the forms that occur. Still over 60 species have been taken, either within the city limits or at localities near by where the conditions are sufficiently similar to warrant the certainty that they will be found within the area under discussion.

Descriptions of the species have been made as brief as practicable and only the most salient and characteristic marks given. In the Decapoda, where the families are represented by but one or two genera, the diagnosis of the family has been omitted, that of the tribe being thought sufficient. In the Arthrostraca, on the other hand, short diagnoses of the families represented have been presented.

Besides the descriptions, short notes on the station and mode of life of the species are given and also, for what appear to be the rarer forms, the exact locality where taken. As the whole city has not yet been worked over it is to be remembered that many of the species here assigned to restricted localities will be found wherever the conditions are suitable.

Many of the cuts in the work have been copied from various papers by Rathbun, Verrill, Harger and others; the remainder of the figures were drawn by the writer.

The author's thanks are due to Professors Wilson and Dean, for their kindness in offering the use of the laboratory of the department of zoology, Columbia University, and to Professor Crampton for the facilities of the Columbia Laboratory at Bay Shore; also to Prof. S. J. Holmes who has kindly identified some Amphipoda, and to other zoologists who have given advice and encouragement.

It is hoped that this catalogue will serve to stimulate the interest in this group of the Crustacea. The writer will be glad to receive notes as to the occurrence of any species, and will be pleased to identify any forms that may be sent to the State Museum.

DESCRIPTION AND DEFINITION OF THE PHYLUM ARTHROPODA

As a preliminary to the catalogue it may be well to give some definition and explanation of the division to which the class described belongs and of the class itself. This great division, or phylum, is characterized by bilateral symmetry as in the lower phylum, the Annulata or worms, and as in that group the body is divided into segments. An advance over the Annulata, however, is in the presence of jointed appendages attached to the segments and from this circumstance it has received the name Arthropoda (Greek $\alpha\phi\theta\rho\omega$, a joint, $\tau\omega\zeta$ foot).

The Arthropoda are divided into five classes:

- 1 Crustacea, including lobsters, shrimps, crabs, barnacles, water fleas etc.
- 2 Onychophora, with only one genus, Peripatus
- 3 Myriopoda: centipedes and millipedes

4 Insecta: insects

5 Arachnida: spiders, scorpions, mites etc.

A part of the Crustacea are treated in the present catalogue.

The name Crustacea implied to early zoologists an animal with a hard but flexible shell, in distinction from the Testacea in which the shell was hard and brittle, as in the clam or oyster. The insects and other groups have, however, a hard and flexible shell, so that this will not serve as a distinction.

On comparing the classes we find that a much greater portion of the Crustacea than of the other groups is aquatic and the breathing apparatus is of a different character. The insects, myriopods and Peripatus breathe through a series of tubes or tracheae, which carry the air to all parts of the body, while in the Crustacea there are no tracheae and the blood becomes aerated either in certain localized regions, the gills, or else over the general body surface.

In completing the definition of the class it would be well for the student to have before him some more or less familiar crustacean and examine its structure.

Take then the crayfish or lobster, which differ but little from each other and are common though they can not be called typical Crustacea in the sense that they exhibit crustacean characters in their simplest form.

First, we observe that the body is segmented. This is not so obvious in the anterior part of the crayfish, for the head and thorax are fused together into a cephalothorax, which is covered by a fold of the integument, the carapace. The presence of appendages shows, however, that this part of the body is composed of segments fused together. The abdomen is distinctly segmented.

The cephalic region or head in the crayfish, as in all Crustacea, is composed of a prostomium and five segments, all indistinguishably fused. It bears two pairs of feelers, the anterior of which are known as the antennulae and the posterior as the antennae. Then follow a pair of eyes, stalked, in the order to which the crayfish belongs. On the underside of the head are the mouth parts which consist of a pair of mandibles or jaws and two pairs of maxillae.

If the second pair of maxillae be examined carefully, it will be found that they are biramous, that is consist of a basal joint which bears two rami or branches, known respectively as exopodite and endopodite. This may be termed the typical form of a crustacean limb, but it is often modified by the loss of one of the rami, the exopodite. This is true of the mandibles and the first maxilla.

The thoracic region, which follows and which, as mentioned above, in the crayfish is fused with the head, bears eight pairs of appendages. Of these the first three are comparatively small, are biramous, function as accessory mouth parts and are known as maxillipeds. The next five pairs are large with only a single branch representing the endopodite and serve as the walking legs. The first pair of them are largest and the penultimate joint is produced distally to form a projection against which the ultimate joint bites, thus forming a claw or chela. The next two pairs are chelate also, while the last two are simple.

To the bases of these appendages are attached long plumose hollow gills which are covered over and protected by the carapace. Another set of gills is also attached to the inner wall of this chamber directly above the preceding.

The appendages of the third, fourth and fifth segments of the abdomen are biramous and delicate and are used to aid in swimming, and by the female as a place of attachment for the eggs. The sixth pair are also biramous but are broad and flattened and together with the last joint or telson (which is without appendages) form a fanlike tail fin. With the aid of this and by suddenly bending the body, the crayfish can give a swift leap backward through the water.

The appendages of the second abdominal appendage in the female, and of the first and second of the male, are modified into genital organs.

Examine now another form of Crustacea, less familiar than the crayfish or lobster, but exhibiting the crustacean characters in greater simplicity: the common fresh-water amphipod, *Gammarus fasciatus*, found everywhere in fresh-water ponds. One of the

beach fleas or one of the common salt-water Gammarids will do as well.

In this form [fig.1] the fusion of the segments has not taken place to the extent that it has in the crayfish. The head consists of the prostomium and five fused segments, and to them is added

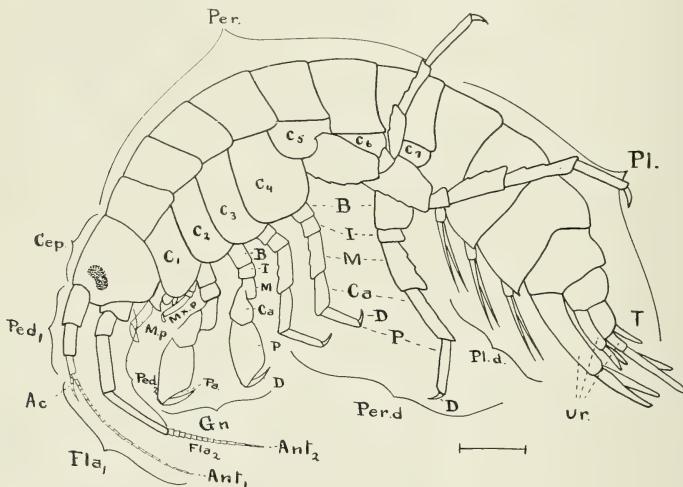


Fig. 1 Diagram of *Gammarus fasciatus*

Divisions of body: *Cep*=cephalon or head; *Per.*=pereion, thorax or mesosome; *Pl.*=pleon, abdomen (the first three segments of this are sometimes called the metasome, the last three urosome)

Appendages of cephalon: *Ant*₁=antennula or superior antenna; *Ped*₁=peduncle; *Fla*=flagellum; *Ac*=accessory or secondary flagellum; *Ant*₂=antenna or inferior antenna; *Ped*₂=peduncle; *Fla*₂=flagellum; *M*, *P*=mandibular palp; *Max*, *B*=maxilliped

Appendages of pereion: *Gn*₁=first gnathopod; *Gn*₂=second gnathopod; *Per.d*=pereiopoda
Joints in all the legs: *C*=coxa; *B*=basis; *I*=ischium; *M*=merus; *Ca*=carpus; *P*=propodus; *D*=dactylus; *Pa*=palm of gnathopod

Appendages of pleon: *Pl.d*=pleopoda; *Ur*=uropoda; *T*=telson
[]=length of animal from front of head to end of terminal uropod ♂=male
♀=female

one thoracic segment, but there is no carapace. The remainder of the segments are all free.

The head bears a pair of sessile eyes, that is eyes without a stalk, a pair of antennulae [*Ant*₁] and a pair of antennae [*Ant*₂]. Each of these consists of a peduncle [*Ped*] of three and four joints respectively and a flagellum [*Fla*] of many joints. In addition to this, the antennulae bear a very short accessory flagellum [*Ac*]. The mouth parts are quite similar to those of the crayfish, consisting of mandibles and two pairs of maxillae. The mandibles in the Amphi-

poda may or may not bear a jointed appendage known as a palp [*M. p.*]. This is frequently of value in determining the species, and when present, either it appears projecting as in the figure, or, frequently in alcoholic specimens, the end of it may be seen between the bases of the antennulae.

As only one thoracic segment is fused with the head, there is but one maxilliped [*Mx. p.*], which is small.

The seven following segments constitute the thorax or pereion [*Per*]. Its first two pairs of appendages, corresponding to the second and third maxillipeds of the crayfish, are large and known as gnathopoda [*Gn*]. They consist, as do the following five pairs of legs, of six joints attached to a base plate, the coxa [*C 1-7*]. The six joints beginning at the proximal end are named basus [*B*], ischium [*I*], merus [*M*], carpus [*Ca*], propodus [*P*] and dactylus [*D*]. The ultimate joint, the dactylus, is bent back on the propodus so as to form a sort of chela, or, as it is termed, a subchela.

The next five pairs of legs are the pereiopoda. The first two are of moderate size and the last three are larger and adapted for leaping or walking.

The last six segments are the abdomen or pleon [*Pl*]. The three anterior of them are larger than the rest and bear delicate biramous appendages, the pleopoda [*Pl. d.*], which function as swimming organs. The last three appendages are the uropoda [*Ur*] and are biramous, stout and assist in leaping.

The last pair of them, known as the terminal uropoda, differ frequently in other species, from the preceding pairs and afford valuable diagnostic characters. The terminal segment of the body, the telson [*T*], as in the crayfish, has no appendages and is small. It also varies greatly in the different species.

The breathing organs of this group are in the form of lamellar sacs attached to the bases of the pereiopoda.

The eggs are carried in a brood pouch formed of plates attached to the pereion of the female.

Comparing now the two forms, we see that, in spite of their dissimilar appearance, they are composed of the same elements, though the elements may be greatly modified for different purposes. These

modifications are carried out in every direction and form the basis for the division into orders, families, genera and species.

It is certain too that in no other group of animals are there such wide deviations from what may be regarded as a typical form, such as the second one described above, or such extreme modifications in adaptation to particular or special modes of life. It may even be carried to the extent of the entire loss of all crustacean characters, as in *Sacculina*, a parasite on a crab, where in the adult there is no sign of segmentation, no appendages, no mouth, just a sac with a number of rootlike filaments extending through the body of the host. It is only by its developmental history that we know it to be a crustacean.

This variation takes place to a certain extent even within the groups of closely related forms which are regarded as a tribe or a family and explains the frequent use of the words "usually" or "generally" in the diagnoses, or the terms "with or without" a certain part.

The sexes in the Crustacea are usually separate, and the eggs are carried by the female either in a brood pouch or attached to the limbs. The young, in most cases, hatch in a free swimming form so unlike the parent that formerly they were regarded as distinct species. This larva grows by a series of molts whereby it gradually increases in size and attains the adult form. In other words there is indirect development or a metamorphosis.

In other cases, such as in the crayfishes and the Arthrostaca, the young are very like the parent, differing only in small details, and the development is direct.

Owing to the hardness of the integument, which is incapable of growth, increase in size in the Crustacea is obtained by the shedding of the hard shell and the formation of a new one underneath. This new one is soft and thus allows a certain increase in size, but it soon hardens. A familiar example of this soft condition after molting is seen in the "soft shell crab."

The Crustacea as a class may be regarded as holding a very similar place in the economy of the ocean to that of the insects on the land. Like the insects, they are widely distributed, hardly any place being

without its representatives, modified to suit the conditions. Minute forms belonging to the lower orders swarm at the surface of the ocean and together with the young of the higher orders, form an important supply of food for fishes and other animals. Other similar species inhabit fresh water, and no roadside pool is without them. Crawling over the bottoms of the bays and sounds, or buried in the sand or mud, other varieties, usually larger and belonging to the higher orders, may be found, while along the shores, under stones or heaps of debris or rockweed, or living among the algae on piles, or even in the piles themselves, are many others.

Some also have been modified for a terrestrial life and may even be said to have become domesticated; for certain of the sow-bugs are rarely to be found except in the vicinity of human habitations.

A few of the leading forms have been made use of directly as food, but the economic importance of the group as a whole is mainly indirect.

The literature of the group is very extensive and dates back to early times, though the early papers were of but little importance. Even as late as 1840 it was still possible for Milne-Edwards to write a *Histoire naturelle des Crustaces* and tell practically all that was known concerning them, but the group has now grown far beyond such bounds and most of the works deal with orders or smaller groups. Consequently the greater part of the literature had best be given under the heads of the different orders, but the following general works may be mentioned here.

De Kay, J. E. Zoology of New York. pt6 Crustacea. Alb. 1844.

Milne-Edwards, A. Histoire naturelle des Crustaces. Par. 1834-40.

Rathbun, R. Fisheries and Fishery Industries of the United States.

Sec.1, pt5. Wash. 1884.

Economic and food values of Crustacea.

Sars, G. O. An Account of the Crustacea of Norway. Christiania and Copenhagen. 1895—.

Diagnoses of families etc., with short descriptions and figures of the species; not yet completed.

Say, Thomas. An Account of the Crustacea of the United States.

Acad. Nat. Sci. Phila. Jour. 1817-18. v.1.

The first important work on American Crustacea. Gives first descriptions of many common forms.

Smith, S. I. The Stalk-eyed Crustacea of the Atlantic Coast of North America, north of Cape Cod. *Ct. Acad. Arts and Sci. Trans.* 1878-82. 5:27.

Stebbing, T. R. R. A History of Crustacea, Recent Malacostraca. *Internat. Sci. Ser.* 71. New York. 1893.

Stimpson, W. Marine Invertebrata of Grand Manan. *Smithsonian Contributions to Knowledge*, 6. Wash. 1854.

Underwood, L. M. List of the Described Species of Fresh-water Crustacea from America, north of Mexico. *Ill. State Lab. Nat. Hist. Bul.* 1886. 2:323.
Index of species described to that date with principal references.

Verrill, A. E. Invertebrates of Vineyard Sound. *Com. Fish and Fisheries Rep't.* Wash. 1874.
Descriptions and accounts of the habits of many common species.

CATALOGUE

The Crustacea are divided into two subclasses: 1 Entomostraca, 2 Malacostraca.

Subclass 1 **ENTOMOSTRACA**

Crustacea of comparatively simple organization and usually of small size. Except in the parasitic forms and the barnacles the typical crustacean number of head appendages are present, but the thoracic and abdominal appendages are very variable in number and are little differentiated. A large carapace is frequently present, being sometimes in the form of a bivalved shell. The young usually hatch in a very primitive, free-swimming stage known as the nauplius.

But little has been done on this subclass in New York; and it is still far too early to attempt a catalogue of the species.

Subclass 2 **MALACOSTRACA**

Crustacea, usually of considerable size and more highly organized than those of the preceding subclass. The number of segments is constant, there being (except in one order, not represented in New York) a thorax of eight segments and an abdomen of seven. In all the orders represented here, one or more of the thoracic segments are fused with the head to form a cephalothorax, which in some of the orders is covered by a carapace. The thoracic appendages are more highly differentiated than in the Entomostraca and are often strikingly modified in connection with their various functions. One or more pairs of them usually act as accessory mouth parts and are known as maxillipeds.

With but few exceptions, the nauplius stage, in which the young of the Entomostraca hatch, is passed through in the egg, but except in one order, the young hatch in a form very unlike the parent and thus undergo a metamorphosis.

The members of this group are more familiar to the ordinary observer, as it includes, among others, the crabs, lobsters, crayfish, the beach fleas and the sow-bugs.

The Malacostraca are divided into six orders, of which all but the first are represented in New York city: 1 Phyllocarida, 2 Schizopoda, 3 Decapoda, 4 Stomatopoda, 5 Cumacea, 6 Arthrostraca.

Order 1 PHYLLOCARIDA

Small Malacostraca which have some of the characters of the Entomostraca and form a connecting link between them and the Malacostraca. Head and thorax with malacostracan number of segments, with a bivalved carapace, and with feet leaflike. Abdomen with eight segments, with biramous appendages and a pair of caudal stylets.

The principal genus is *Nebalia*, and a species of this, *N. bipes* Fab., is common in the North Atlantic but has not been taken as far south as New York.

Order 2 SCHIZOPODA

Malacostraca in which the thoracic appendages are all biramous, and the anterior ones are only to a slight extent modified as maxillipeds. A thin, soft carapace is present but does not cover the posterior segments. Eyes stalked.

A small group of forms which are known as opossum shrimps, three species of which are found in New York city waters.

Mysis stenolepis Smith

Mysis stenolepis Smith. In Verrill. *l. c.* 1874. p. 551.

Body more or less cylindric. Carapace produced into a short, blunt rostrum: inferior angle with a sharp tooth. Antennal scale rather longer than carapace, ciliated; flagellum of antennae as long as body. Abdomen somewhat geniculated between first and second segments. Inner lamellae of the sixth segment slightly longer than telson.

Length: male 23 mm, female 30 mm. Color white, marked with black pigment spots, somewhat stellate in form.

Very common in the eelgrass in Great South bay.

Two other species of Schizopoda will probably be found, both smaller than the preceding. *Mysis americana* Smith, measures 10-12 mm and the antennal scale is but three quarters the length of the carapace. The inner lamella of the sixth abdominal segment is as long as the telson. Found among eelgrass.

Heteromysis formosa Smith is still smaller, males measuring 6 mm and females 8 mm. The first pair of legs differ from those of *Mysis* in having the terminal portion, which is multiarticu-

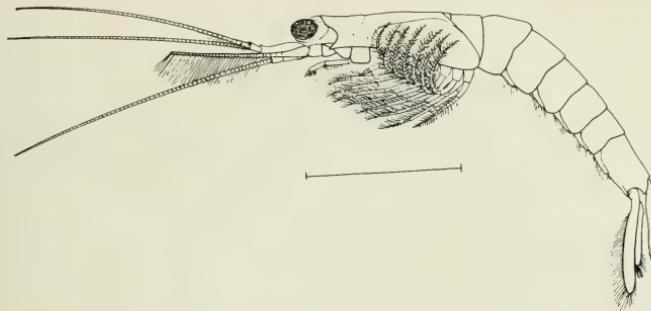


Fig. 2 *Mysis stenolepis* (Modified from Verrill)

late in that genus, composed of but three joints. The males are colorless and transparent and the females rose-colored.

Found in colonies, often in the dead shells of bivalve mollusks.

Order 3 DECAPODA

Malacostraca in which the head and thoracic segments are united to form a cephalothorax, which is usually covered by a carapace. The first three pairs of thoracic appendages are maxillipeds, while the following five pairs are, as the name Decapoda implies, the walking legs. In these the exopodite or outer branch of the typical crustacean limb has disappeared, leaving the leg uniramous. The first leg is usually larger than the others and by the growth of the penultimate segment, forms a claw or chela.

They breathe by gills which are hollow outgrowths from the bases of the thoracic legs or of the thoracic wall and which are covered by the carapace. The eyes are stalked.

The Decapoda is a large group and contains the largest and most striking of the Crustacea and has consequently been the most studied. The literature is therefore extensive; but besides the works already referred to under Crustacea any other important ones will be mentioned under the separate species.

The Decapoda are divided into two suborders: *a* Macrura, *b* Brachyura.

Suborder *a* MACRURA

Decapoda in which the cephalothorax is usually longer than broad and the abdomen is large and well developed and carried straight out behind. The second pair of antennae are long and many jointed and the last pair of maxillipeds are leglike. The walking legs are well developed and have the terminal joints of one or more of them modified into chelae. The abdominal appendages are generally all present, and the last pair, the uropoda, are broader and form, with the terminal segment, a tail fin.

The eggs are carried attached to the abdominal appendages of the female, and the young are hatched in a free-swimming form quite unlike the adult. This varies, however, greatly in different forms, and in the crayfishes the newly hatched young are very like the adult in everything except size.

This suborder includes the shrimps and prawns, which are found, sometimes in great numbers, among the seaweeds on piles or wharves. The lobster, which is now extinct in New York city, belongs in this group, as does the crayfish, common in the brooks.

Keys to the macrurous Crustacea of North America are to be found in the *American Naturalist*, 1899, v.33, as follows: "The Caridea," J. S. Kingsley, p.709; "Astacoid and Thalassinoid Crustacea," J. S. Kingsley, p.819; "The Astacidea," W. P. Hay, p.957.

The Macrura are divided into four tribes: 1 Caridea, 2 Astacidea, 3 Thalassinidea, 4 Anomura.

1 CARIDEA

Small or moderate sized forms with a rather compressed body. Carapace smooth and without sutures and produced into a longer or shorter rostrum, frequently toothed. The carapace is not fused in front with the epistome (the frontal region between the eyes). Antennae with a large scale. The thoracic legs are generally long and delicate, one or more of the anterior ones being chelate.

This group includes the shrimps and prawns, and our common species represent the three families Crangonidae, Palaemonidae and Penaeidae.

Family CRANGONIDAE

Crangon vulgaris Fab.*Shrimp*

Crangon vulgaris Fabricius. Ent. Syst. Sup. 1798. p.410. Verrill. l. c. 1874. p.550, pl.3, fig.10.

Crangon septemspinosis DeKay. l. c. 1844. p.25, pl.8, fig.24.

Carapace flattened on dorsal surface and with a minute flattened rostrum. Antennulae biflagellate, outer flagellum about as long as antennal scale, inner slightly longer. Last pair of maxillipeds pediform. First pair of legs largest and subchelate, second pair smallest.

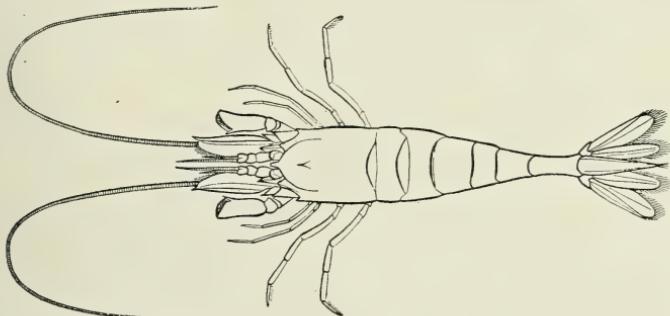


Fig. 3 *Crangon vulgaris* (After Verrill)

Length 50 mm. Color light, but thickly spotted with dark gray or black markings, which cause it to resemble closely the sand. In muddy localities, where the bottom is darker, the spots are more numerous and larger, so that the animals have an almost uniform color.

They are found on the bottoms of the bays in shallow water, either lying upon the sand or buried in it with only the eyes and antennae exposed. It is a very active form, springing quickly away when any attempt is made to capture it but it needs all its powers of concealment and action, for it is hunted by many fishes, and, according to Verrill, it constitutes the principal food of several species, among which are the weakfish, bluefish, flounders, striped bass etc.

It is a very widely distributed species, occurring all over the northern hemisphere. It is the edible shrimp of Europe.

Family PALAEMONIDAE

Palaemonetes vulgaris (Say)*Prawn*

Palaemon vulgaris Say. *l. c.* 1818. p.248. DeKay. *l. c.* 1844. p.29, pl.9, fig.30.

Palaemonetes vulgaris Verrill. *l. c.* 1874. p.550. pl.2, fig.9.

Characterized by the presence of a straight, thin rostrum, as long as the carapace, and with eight or nine teeth above and four below. Antennulae triflagellate, longer branches two thirds the length of the antennae, which are slightly longer than the body. Second pair of feet larger than first and both chelate.

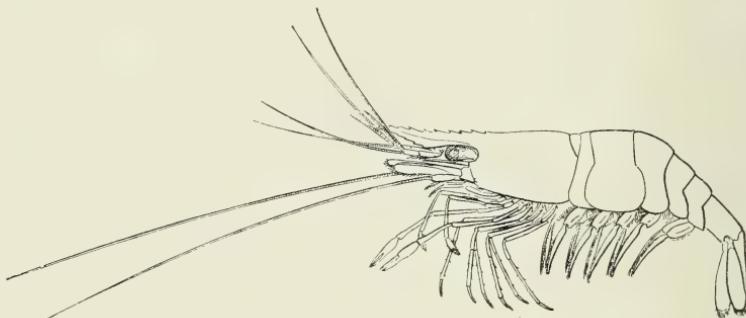


Fig. 4 *Palaemonetes vulgaris* (After Verrill)

Length 45 mm. Translucent and almost colorless, with irregular spots of brown and black.

Found in great numbers in the eelgrass or clinging to the *Fucus* on piles and wharves. It appears to like brackish water and runs up at times to where the water is entirely fresh. Important as a food for fishes.

Virbius zostericola Smith

Virbius zostericola Smith. In Verrill. *l. c.* 1874. p.550, pl.3, fig.11

Female, rostrum straight and as long as carapace, with two (rarely three) teeth on upper edge and three (sometimes two or four) on lower. Carapace smooth, armed with three spines on anterior part. Inner flagellum of antennae extending slightly beyond tip of antennal scale, outer flagellum much shorter. Abdomen geniculated at third segment, the posterior margin of which is prominent but not

acute. Males, smaller, more slender and with rostrum narrower vertically.

Length: female 20-26 mm, male 15-20 mm. Color translucent, usually bright green or pale with specks of brown or red and a broad median band of dark brown. Found among the eelgrass and taken in Jamaica bay.

Virbius pleuracanthus Stimp. may also be taken. It may be distinguished from the above by the shorter rostrum.



Fig. 5 *Virbius zostericola* (After Verrill)

Another much larger shrimp, measuring six inches in length, is occasionally taken in Great South bay and in the Hudson. This is the edible shrimp of the southern states, *Penaeus brasiliensis* Lat. and it belongs to the family Penaeidae.

2 ASTACIDEA

Moderate or large sized forms with a rather stout body. Antennal scale small or wanting. No longitudinal sutures, but a transverse suture separating the cephalic from the thoracic region, may be present. Carapace united in front with the epistome. First pair of thoracic legs in our forms are large and chelate and the two following pairs may also bear small chelae.

Our representatives of this tribe are the lobster and the crayfish, both of which belong to the family Astacidae.

Homarus americanus Mil.-Edw.

Homarus americanus Milne-Edwards. Hist. Nat. des Crus. 1837. 2:334. Herrick, F. H. U. S. Fish Com. Bul. for 1895. p.1, pl.A-J and 1-54.

This, the well known edible form, is no longer to be taken within the limits of New York city, the constant fishing to which it was subject, as well as the pollution of the water, having completely exterminated it.

A very complete description of its life history, habits etc. and a full literature list are to be found in the paper of Herrick's cited above.

***Cambarus bartonii* (Fab.)**

Crayfish

Astacus bartonii Fabricius. Ent. Syst. Sup. 1798. p.407. DeKay. I. c. 1844. p.22, pl.8, fig.25.

Cambarus bartonii Hagen, H. A. Mus. Comp. Zool. Mem. 1870. v.2, no.1, p.75.

Faxon, W. Mus. Comp. Zool. Mem. 1885. v.10, no.4.

Huxley, T. H. The Crayfish.

This is the well known crayfish and is the only species of the genus so far found in New York city, so that it is unnecessary to

give any description of it. The genus is moreover a very perplexing one, and any one making a study of it should consult the works of Hagen and Faxon mentioned above.

Crayfishes are found under stones in the beds of small brooks or in springs, where they lie with their heads and antennae out, waiting for a small fish or a worm and ready to spring back at any sign of danger. In larger brooks with muddy banks they make burrows and are indeed a considerable nuisance in canals, as they undermine

the sides, sometimes causing disastrous cave ins.

They either walk slowly along the bottoms on the tips of their legs, with the large chelae held straight out in front, or propel themselves backward through the water in a series of leaps, by the bending of the abdomen with its fanlike fin.

The eggs are large, and the young do not undergo any metamorphosis, being hatched in a form very similar to the adult.

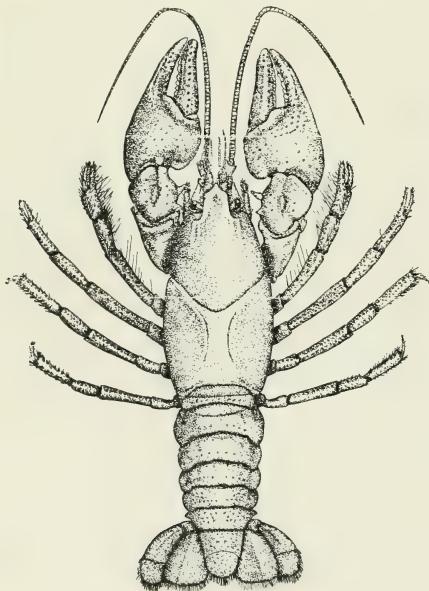


Fig. 6 *Cambarus bartonii*

3 THALASSINIDEA

Moderate sized forms with two longitudinal dorsal sutures and with a cervical suture frequently present. First thoracic legs usually large and chelate. Abdomen large. Burrowing forms.

Representatives of this group have not so far been taken within the city limits, but species of the genera *Callianassa* and *Gebia* may possibly be found. They inhabit deep burrows in the mud or muddy sand.

4 ANOMURA

Aberrant forms, at one time placed in a class by themselves but now united with the Macrura. Its principal diagnostic character is the reduction of the last pair of thoracic legs and their dorsal position. It includes the family Hippidae, the sand-bugs, and the Paguridae, the hermit crabs.

Family HIPPIDAE

Hippa talpoida Say*Sand-bug*.

Hippa talpoida Say, T. Acad. Nat. Sci. Phila. Jour. 1817. 1:160. DeKay. l. c. 1844. p.18, pl.7, fig.17. Verrill. l. c. 1874. p.548, pl.2, fig.5.

An oval and very convex form, with numerous longitudinal stria-
tions on the anterior portion of the cephalothorax. Eyes small and on long stalks. Second antennae as long as thorax and fringed with long hairs. First four thoracic legs large, not chelate, and adapted for burrowing. Terminal segment of abdomen long and triangular and folded close under the body.

The smooth surface and peculiar form of this species render it the most rapid burrower on our shores. It lives in the sand near low water mark, and, if dug out, will rapidly disappear again, going down into the sand backward.

Length 25 mm. Color yellowish white tinged with purple.

Occurs on the exposed southern shore of Long Island.

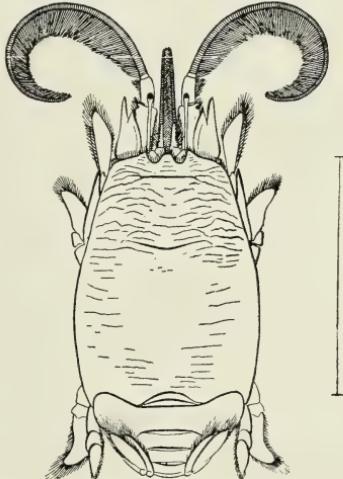


Fig. 7 *Hippa talpoida* (After Verrill)

Family PAGURIDAE

a **Eupagurus pollicaris** (Say)

b **Eupagurus longicarpus** (Say)

Hermit crabs

a **Pagurus pollicaris** Say, T. Acad. Nat. Sci. Phila. Jour. 1817. 1:162. DeKay. l. c. 1844. p.19, pl.8, fig.21.

Eupagurus pollicaris Verrill. l. c. 1874. p.548.

Pagurus longicarpus Say, T. l. c. 1:163. DeKay. l. c. 1844. p.20, pl.8, fig.22.

Eupagurus longicarpus Verrill. l. c. 1874. p.549. Kingsley, J. S. Am. Nat. 1888. 22:888.

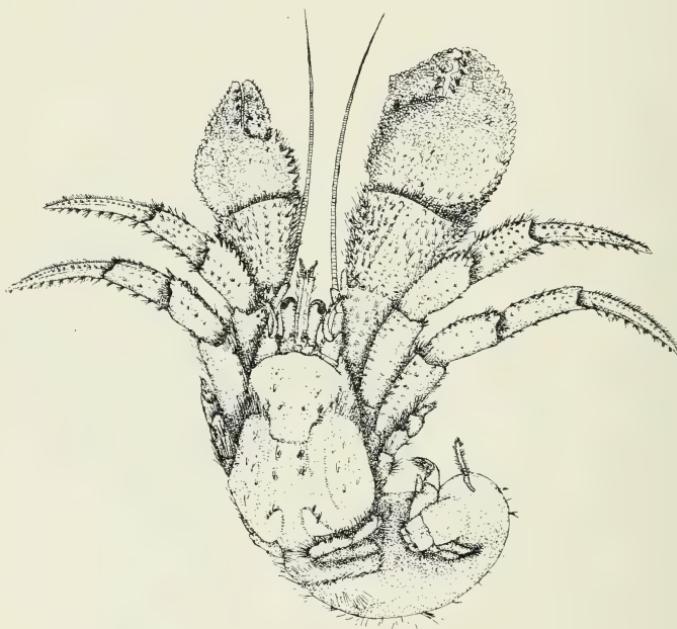


Fig. 8 **Eupagurus pollicaris**

Asymmetric forms with abdomen large but its integument not calcified. Abdominal appendages much reduced. Inhabit empty gasteropod shells.

In order to protect their soft abdomen, these forms ensconce themselves in empty gasteropod shells, and from this circumstance are known as hermit crabs, having a fancied resemblance to a hermit in his cell.

The first pair of thoracic legs are large and chelate, the right being generally larger than the left. The next two pairs are also large and end in simple points, and the last two pairs are much reduced. The abdominal appendages are more or less atrophied, except the last, which are modified into hooks for holding on to the columella of the shell. In the male these are the only pair present, but in the female the others are slightly developed, and to them the eggs are attached as in the other Macrura.

As the animal increases in size, it takes a larger shell, sometimes killing and eating the original inhabitant and sometimes taking a dead shell which suits it. Considerable has been written on the habits of these forms, and interesting accounts may be found in the works of Verrill and Kingsley cited above. These forms are easily kept in an aquarium.

Of the two species *E. longicarpus* is much the commoner and may be found on the sandy bottoms of the bays everywhere. It is the smaller form and usually occupies the shells of *Ilyanassa* or *Anachis*, though any small shell may be used. It may be distinguished by its size and by its elongated and smooth chelae.

In *E. pollicaris*, on the other hand, the chelae are shorter, stouter and covered with tubercles, and together they form an operculum to close the opening of the shell. This species occupies the shells of *Natica* and *Sycotypus*, and is found occasionally under rocks at low water, but usually occurs in deeper water on rocky or shelly bottoms.

E. longicarpus is frequently found covered with a variety of Hydroid, *Hydractinia polyclina* Agas. a case of commensalism.

Suborder *b* BRACHYURA

Decapoda in which the body is proportionally very broad, frequently broader than long, and in which the abdomen is much reduced and permanently flexed in a groove on the underside of the cephalothorax. The antennae are short, and the third maxillipeds are flattened and platelike, forming a covering for the other mouth parts. The first pair of legs are larger than the others and are modified into chelae. The other four pairs terminate in points

or the last pair may be flattened to form a finlike organ. The abdominal appendages are much reduced, two pairs being found in the male and one in the female.

The eggs, which are usually much smaller in proportion than in the Macrura, are carried attached to the hairs of the abdominal appendages of the female. The young are hatched in a form very different from the adult and known as a zoea. It is a free-swimming form, characterized by the presence of but two pairs of legs, which represent the second and third pairs of maxillipeds of the adult. The other appendages appear gradually at the successive molts of the animal, though up to a certain stage it still retains the zoea form. At that molt, however, it suddenly changes, attaining a form very similar to that of the adult, but with the abdomen held straight out behind instead of flexed. This is known as a megalops and by a further series of molts it attains the definitive crab form.

This order includes the crabs, among which the blue, or edible crab is familiar to everyone. Besides this, the large lady crab, the green crab and the spider crabs are found, walking over the bottoms of the bays or concealed under the seaweeds. Small mud crabs are found under stones in muddy situations, and the odd looking fiddler crabs occur on the marshes.

Keys to the Brachyura of North America by Mary J. Rathbun are to be found in the *American Naturalist*, 1900, v.34, as follow: "Cyclometopous or Cancroid Crabs," p.131; "Oxyrhynchous and Oxystomatous Crabs," p.503; "Catometopous or Grapsoid Crabs," p.583.

The Brachyura are divided into four tribes: 1 Cyclometopa, 2 Oxyrhynca, 3 Catometopa, 4 Oxystomata.

These may be separated by the form of the carapace and the front, that is the portion between the eyes. The Oxystomata are not represented.

1 CYCLOMETOPA

Cancroid crabs. Carapace usually broader than long and regularly arched in front. No rostrum.

Divided into three families, Cancridae, Pilumnidae and Portunidae, all of which are represented.

Family CANCRIDAE

Cancer irroratus Say*Rock crab*

Cancer irroratus Say, T. (male only, the female being *C. borealis*) Acad. Nat. Sci. Phila. Jour. 1817. p.59, pl.4, fig.2. Verrill. *l. c.* 1874. p.546. Smith. *l. c.* 1878. p.38.

Platycarcinus irroratus De Kay. *l. c.* 1844. p.6, pl.2, fig. 2.

Carapace rounded, with nine blunt teeth on each side of the anterior part. Last pair of legs end in points.

It is a northern form, being the common crab of the New England states, but extends down into New Jersey. It is found

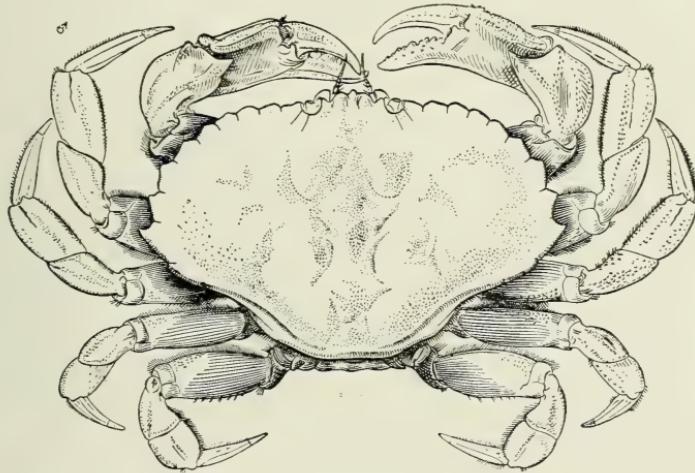


Fig. 9 *Cancer irroratus* (After Rathbun)

under large rocks near low water or buried in the sand or gravel beneath them, but may also occur on the sandy beaches.

Length of carapace 75 mm, breadth 100 mm. Color light, but thickly spotted over with many small red dots which give the prevailing color.

The allied species, *C. borealis* Stimpson, the northern crab, may possibly be found within the city limits. This is a rather larger and heavier species than *irroratus* and frequents rocky localities, usually being found on the rocks, and not underneath. Farther north it is found cast on the beaches in considerable numbers. It possesses the nine lateral teeth, but those on the side are more pointed, and the carapace is rougher than in *irroratus*.

Family PILUMNIDAE

Panopeus harrisii (Gould)**Panopeus depressus** Smith**Panopeus sayi** Smith*Mud crabs*

Pilumnus harrisii Gould, A. A. Invert. of Mass. 1841. p.326.
DeKay, J. E. l. c. 1844. p.7, pl.7, fig.15.

Panopeus depressus and *P. sayi* Smith, S. I. Soc. Nat. Hist. Bost. Proc. 1869. 12:283 and 284.

Benedict, J. E. & Rathbun, M. J. The Genus *Panopeus*. U. S. Nat. Mus. Proc. 1891. 14:355.

Small forms with dull colors, carapace broader than long and with several short teeth. Last pair of legs somewhat flattened but ending in points.

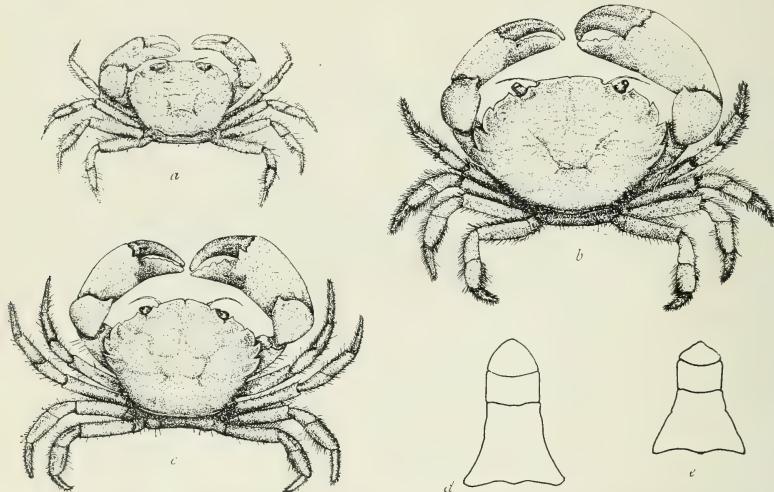


Fig. 10. a—*Panopeus harrisii*; b—*P. depressus*; c—*P. sayi*; d—abdomen of male of *P. depressus*; e—of *P. sayi*

Panopeus is a large genus with many species closely resembling each other, and three of them are found within the city limits. They are all small and have similar habits, being, as their name indicates, mud-inhabiting forms. In muddy localities they are found in considerable numbers, under stones below high water mark, and extend from there out into deeper water. They are very common on the oyster beds, and many are brought up by the tongs

and dredgers. In these localities they appear to be fond of living within the dead shells of oysters which are slightly gaping and filled with mud, but they will take up their abode in almost any crevice they can find. The red sponge, *Microciona prolifera*, is frequently filled with small specimens. They are not at all active in their movements, and probably remain for long periods in their retreats, waiting for their food to come to them. When disturbed however, they try to conceal themselves under the nearest rock or in the mud.

P. depressus and *sayi* are very similar and are frequently found together and may be distinguished from *harrisii* by their larger size and heavier build, and in having the fingers or ends of the larger claws black.

The two species differ in the form of the carapace, an adult specimen of *P. sayi* measuring about 17 mm in length by 22.5 mm in breadth, a ratio of 1 to 1.34. *P. depressus* is broader in proportion to its length, a New York specimen measuring 26.5 mm by 18 mm, a ratio of 1 to 1.47. The carapace of *sayi* is also more swollen and convex than that of *depressus*, and the front is arcuate in the former and nearly straight in the latter. The terminal segment of the abdomen of the male is in *sayi* [fig.10e] broadly triangular and wider than long, while in *depressus* [fig.10d] it is more nearly an equilateral triangle.

P. harrisii is found near high water mark and is rarer than the others. Adults measure 14 by 11 mm, and the carapace has more of a quadrilateral form. The large claws are also more slender and are of a lighter color, and the walking legs are slender and compressed. The transverse lines on the carapace are more prominent than in the others.

Sayi and *depressus* are very common along the shores wherever there are mud and stones, and may always be found there. *Harrisii* has been taken under stones near Flushing and at the Fresh Kills on Staten Island.

Family PORTUNIDAE

Callinectes hastatus Ordway*Edible crab, blue crab*

Callinectes hastatus Ordway. *Bost. Jour. Nat. Hist.* 1863. 7:568.
Verrill. *l. c.* 1874. p.548.

Lupa diacantha DeKay. *l. c.* p.10, pl.3, fig.3.

Callinectes sapidus Rathbun, *M. J. U. S. Nat. Mus. Proc.* 1896.
18:349, pl.12-14.

Carapace twice as long as broad, with a sharp spine at each side. Last pair of legs with the terminal segment flattened. Color dark green.

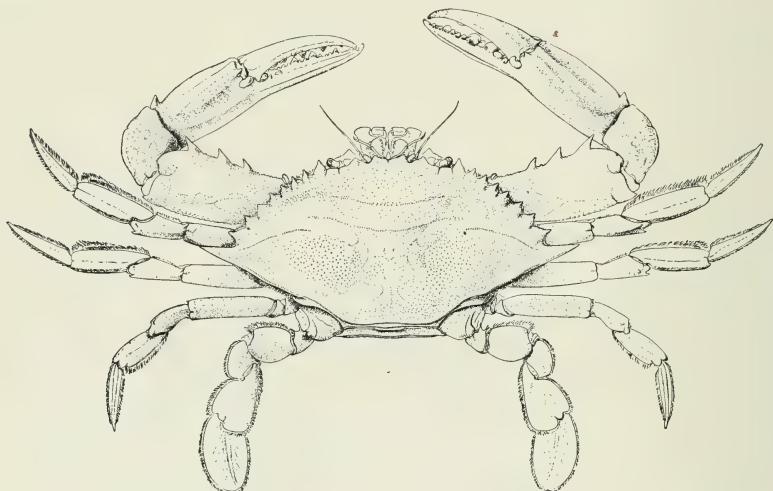


Fig. 11 *Callinectes hastatus* (After Rathbun)

This is the common form sold in the markets and is doubtless the most familiar of the Brachyura to those who are not naturalists. It occurs on the bottoms of the bays or clinging to the seaweeds on the wharves and extends some distance up into fresh water, specimens having been taken at Newburgh. As may be supposed from the finlike posterior legs, it is a good swimmer and may often be found at the surface.

The young do not have the characteristic color of the adult, but are much lighter, with numerous small black spots, and closely resemble the sand and pebbles on which they live. They are just as pugnacious as the adult and, when cornered, dance around, hold-

ing out their claws in a menacing manner, but finally running off sideways and concealing themselves under stones or seaweeds. Interesting accounts of the adults are found in the paper by Rathbun.

The "soft shell crab" of commerce is this species taken after it has shed its hard shell and before the new one has hardened. The operations of catching the crabs about to shed, and keeping and watching them till they do so, form a very important business, whose headquarters are at Crisfield Md. Some of it is done on the shores of Great South bay, L. I. and a short account of the industry has been given by the writer.¹

Crabbing is one of the amusements of the summer population of the shore, the process being to entice the crab within reach by means of a fish head or other bait and then capture him with a net. As the crabs can give a fairly good nip with their strong claws, it is quite liable to afford considerable amusement.

The females with eggs are rarely found in this latitude, as they seem to prefer deeper water, but they are occasionally taken on pound nets. The eggs are small and very numerous.

Length 13 cm across the carapace. Color dark green, white below; feet blue; spines and fingers tipped with red.

Common on southern shore of Long Island and occasionally found on northern.

Platyonichus ocellatus Latreille

Lady crab

Platyonichus ocellatus Latreille. Ency. Meth. 16:152. DeKay. l. c. 1844. p.9, pl.1, fig.1; pl.5, fig.7. Verrill. l. c. 1874. p.547, pl.1, fig.4.

Carapace almost circular, with five acute teeth on each side; last pair of legs flattened and rounded. Color light with red spots.

This is a very handsome species, and according to De Kay the name lady crab is given it on account of the beauty of its coloring. As in the blue crab, the last pair of legs are flattened, so that it is a good swimmer. Its usual habitat is the sandy beaches, even the most exposed, where at low water mark, it buries itself, all but the eyes and antennae and is on the watch for enemies and prey. If

¹ N. Y. State Mus. 55th An. Rep't. 1901. p. 1129-38.

disturbed when feeding or if dug out, it disappears with great rapidity, burrowing backward into the sand. It is predacious, feeding upon other forms, but, like most crabs, will eat dead fish or other animals.

Its cast skin, which is very brilliant with its red spots, is frequently found on the beach.

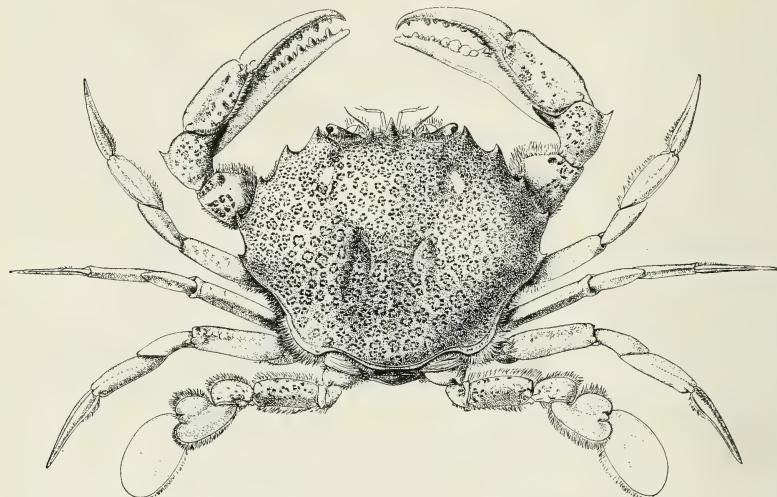


Fig. 12 *Platyonichus ocellatus* (After Rathbun)

This species was described in 1799 by Herbst and its locality given as "Long-Eiland bey Newyork".

Length of carapace 6 cm. Color light, but with numerous bright red or purple spots, which are arranged in circles on the carapace and are largest on the claws.

Sandy beaches.

***Carcinus moenus* Leach**

Green crab

Carcinus moenus Leach. Mal. Podoph. t.v.f.1-4. DeKay. *l. c.* 1844. p.8, pl.5, fig.5, 6.

Carcinus granulatus Verrill. *l. c.* 1874. p.547.

Carapace slightly broader than long, with five acute teeth; posterior legs end in points; color green.

A rather striking looking species, which is found running over the bottoms in shallow water or concealed under rocks or seaweed between tides. It is a very active and pugnacious creature, and the

crab fishermen say that a single green crab will kill all the edible crabs in a shedding car. It has been accused in England of killing and eating the young oysters while their shells were thin. In France, from its excitable nature, it is known as the *crabbe enragé*. It is a favorite article of food all along the European coast.

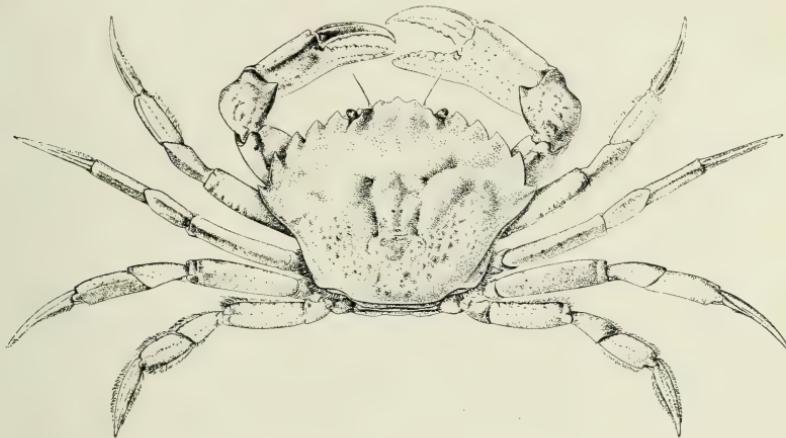


Fig. 13 *Carcinus moenus* (After Rathbun)

Breadth of carapace 5 cm. Color green, variously mottled with shades of yellow.

Occurs all along the coast in suitable localities.

2 OXYRHYNCA

Carapace usually narrow in front, sometimes rounded but always with a rostrum.

Divided into two families, Maiidae and Parthenopidae, of which the first is represented by two species. Members of the other family may possibly occur, but have not been taken.

Family MAIIDAE

Libinia emarginata Leach

Libinia dubia Milne-Edwards

The spider crabs

Libinia emarginata Leach. Zool. Misc. 1815. 2:129. Rathbun. U. S. Nat. Mus. Proc. 1892. 15:235.

Libinia canaliculata DeKay. l. c. 1844. p.2, pl.4. Verrill. l. c. 1874. p.548.

Libinia dubia Milne-Edwards. Hist. Nat. des Crus. 1834. 1:300, pl.14 bis, fig.2. Verrill. l. c. 1874. p.548. Rathbun. l. c. 1892. p.237.

Carapace evenly rounded behind the frontal region; rostrum short and bifid at the tip; body with spines; legs of moderate length.

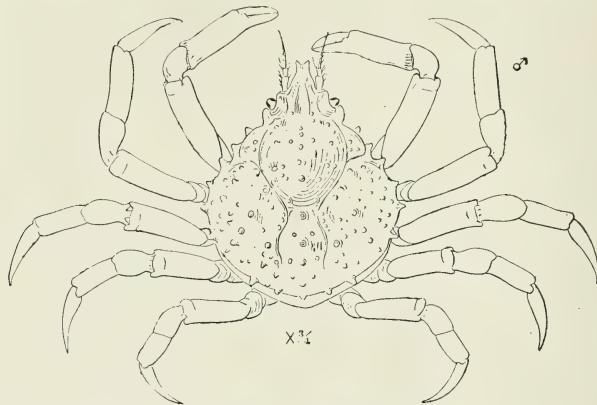


Fig. 14 *Libinia emarginata* (After Rathbun)

L. emarginata may be distinguished from *L. dubia* by the greater number of spines on the carapace and by the median row, consisting in the former of nine, and in the latter of six spines.

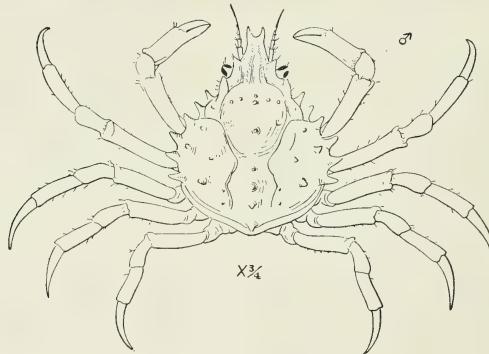


Fig. 15 *Libinia dubia* (After Rathbun)

Both species occur, the former the more commonly, walking over the bottoms of the shallow bays among the eelgrass, and they extend out into deeper water. They are frequently dredged on the oyster beds, and sometimes appear in such numbers that operations have to be suspended till the spiders, as the fishermen call them, have passed over.

They are slow moving animals, and their carapaces are not infrequently so covered with foreign matter, such as worm tubes, living hydroids and algae, that it is difficult to distinguish them from their surroundings. One crab taken had the entire body covered with a soft velvety-looking mass of the hydroid *Hydractinia*, which occurs on the hermit crabs. Members of this family have been observed sticking bits of algae, hydroids etc. on bare spots of the carapace with their pincers.

Length 4-6 cm.

Occurs along the shore in the bays.

The tribe Oxystomata is not represented in New York.

3 CATOMETOPA

Carapace broad anteriorly, often subquadrate, sometimes subglobose; truncate or arcuate anteriorly but always without a rostrum. Front bent downwards. Epistome short.

Of the four families, Ocyopodidae, Grapsidae, Gecarcinidae and Pinnotheridae, representatives of the first and fourth have been taken.

Family OCYPODIDAE

Gelasimus pugilator Latreille

Gelasimus minax Le Conte

Gelasimus pugnax Smith

Fiddler or soldier crabs

Gelasimus pugilator Latreille. *Nouv. dict. d'hist. nat. ed.2*, 1817. 2:520. Smith, S. I. *Ct. Acad. Arts and Sci. Trans.* 1870. 2:113, pl.4, fig.7. Verrill. *l. c.* 1874. p.545.

Gelasimus vocans DeKay. *l. c.* 1844. p.14, pl.6, fig.9 (pars).

Gelasimus minax LeConte. *Acad. Nat. Sci. Phila. Proc.* 1855. 7:403. Smith. *l. c.* p.128, pl.2, fig.4, pl.4, fig.1-1b. Verrill. *l. c.* 1874. p.545.

Gelasimus pugnax Smith. *l. c.* 1870. 2:131, pl.2, fig.1, pl.4, fig.2-2d. Verrill. *l. c.* 1874, p.545.

Gelasimus vocans var. a. DeKay. *l. c.* 1844. p.14, pl.6, fig.10.

Carapace rather quadrangular; one of the first pair of walking legs of the male enormously developed and carried horizontally, both of first pair of female small.

Of the three species *G. minax* is much the largest, and has red spots at the articulations of the joints. *G. pugnax* and *pugilator* are distinguished by the presence in *pugnax* (as

in *minax*) of an oblique ridge across the palm of the large claw, while the palm of *pugilator* is smooth.

These three species are commonly known as "fiddlers"; for, when running over the beach with the large claw held out in front of them and the small one sawing in front of it, they ludicrously resemble a man carrying a bass viol. The old specific name *vocans* was given them because, when the tide was out, they

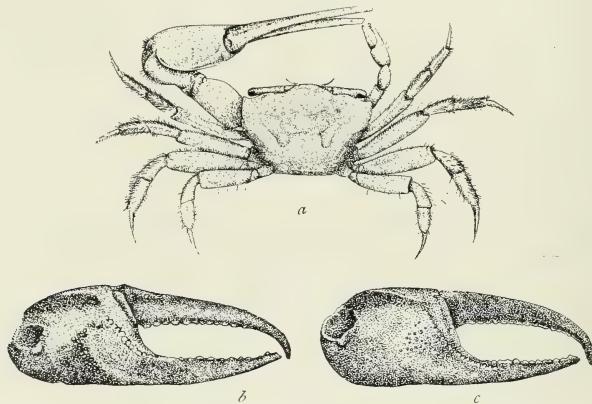


Fig. 16 *a* = *Gelasimus minax*; *b* = claw of *G. pugnax*; *c* = claw of *G. pugilator*

appeared to stand on the beach and wave their great claws, calling it back again.

The species are mostly vegetarians, feeding on algae, which they pick off with their small claws. They live in burrows in the sand and mud, where they are abundant, completely honeycombing it. Their habits and mode of life have been interestingly described by Verrill *l. c.* p.336, and Kingsley, *Am. Nat.* 1888, 22: 888. They are easily kept in captivity, on damp sand, and may be fed on crackers dipped in water.

G. minax and *pugnax* are found on the salt marshes, while *G. pugilator* occurs on sandy or muddy beaches near high water mark and is rarer than the other two. They may be found almost anywhere along the shore, sometimes, as was the case at Rockaway Beach, in such numbers that the entire shore appeared to be in motion.

Family PINNOTHERIDAE

Pinnotheres ostreum Say*Oyster crab*

Pinnotheres ostreum Say, T. Acad. Nat. Sci. Phila. Jour. 1817. 1:67, pl.4, fig.5. DeKay. l. c. 1843. p.12, pl.7, fig.16. Verrill. l. c. 1874. p.546 (figure given is *P. maculatum*).

Carapace rounded, that of female soft and thin, eyes small. Female found only in branchial cavity of oyster.

The members of this genus are noteworthy in that the females live within the branchial cavity of certain lamellibranch mollusks, the present species inhabiting the oyster, while an allied form, *P. maculatum*, lives in the common mussel. The males are free.

These crabs were originally known as *Pinnotheres*, "the guardian of the Pinna," for an allied species in Europe lives in the shell of a lamellibranch, *Pinna*, and was supposed to give warning to the mollusk at the approach of any danger, so that it could close its shell.

The oyster crab is of some economic importance as food, but the difficulty of obtaining a sufficient supply limits its use.

Order 4 STOMATOPODA

Malacostraca with a small carapace which does not cover the last three thoracic segments. The abdomen is proportionally very large, and its first five appendages bear gill filaments. The first five thoracic appendages are maxillipeds, and the last three are small biramous legs. Eyes stalked.

A very small order with only one representative on our coast.

Squilla empusa Say*Mantis shrimp*

Squilla empusa Say, T. l. c. 1818. 1:250. DeKay. l. c. 1844. p.32, pl.13, fig.54. Verrill. l. c. 1874. p.551.

A large form, which, besides the characters of the order, shows the following: Antennulae with three flagella, antennae shorter, with a large scale. The second maxillipeds large and subchelate, the

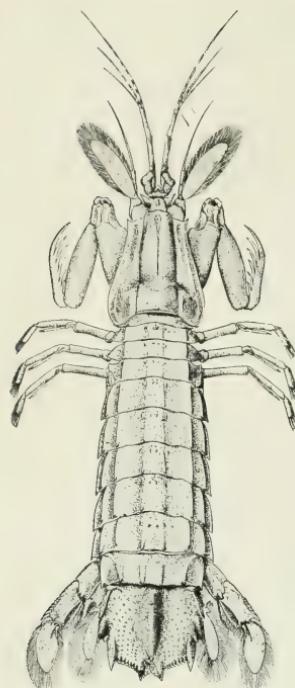


Fig. 17. *Squilla empusa*
(After Rathbun)

serrated dactylus folding back on the propodus like a knife blade. The tail fin is large and armed with spines, which can give a severe dig if the animal is handled incautiously.

It inhabits burrows of its own construction, 15–20 mm in diameter, in the soft mud in shallow water.

Length 15–25 cm. Color yellowish with green, brown and yellow markings.

Taken at Cold Spring Harbor and may be found within the city limits.

Order 5 CUMACEA

A small order of Malacostraca, in which the anterior part of the body is very much larger than the posterior. A carapace is present, covering the anterior segments and leaving never more than five segments exposed.

Abdomen cylindric, flexible, of six segments, the fifth longest.

The members of this order are bottom forms, extending to very great depths and reaching their greatest development in colder

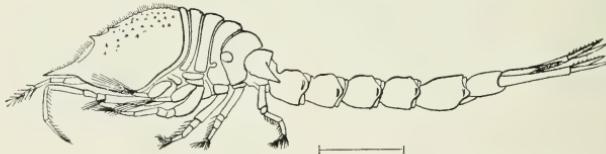


Fig. 18. *Diastylus quadrispinosa* Sars (After Verrill)

waters. None have been taken so far in New York city, but several species will probably be obtained by dredging.

The species of *Diastylus* figured is common, according to Verrill, on soft muddy bottoms in Vineyard sound.

Order 6 ARTHROSTRACA

Malacostraca in which the first, and in some cases the second thoracic segment also, is fused with the head. The remaining segments are free, and there is no carapace. Eyes generally sessile or without stalks.

A large group, none of which attain very great dimensions. The head and the first thoracic segment are indistinguishably fused to form an incomplete cephalothorax, and the first thoracic appendage is a maxilliped. The next seven thoracic segments are free and bear legs, and the abdominal segments may or may not be fused.

The large eggs are carried by the female in a brood pouch formed by flat platelike appendages of certain thoracic legs. There is no metamorphosis, the young being hatched in a form resembling the parent.

Divided into two suborders: *a* Amphipoda, *b* Isopoda.

Suborder *a* AMPHIPODA

Arthrostraca in which the body is usually compressed from side to side. The gills are borne on the thoracic appendages.

The larger suborder of the two. In addition to the above characters, it may be distinguished by the large abdomen, which, except in the Caprellidae, where it is vestigial, is as long as the thorax and has the segments free.

Both pairs of antenna are present and either or both may be well developed. Eyes sessile in all of our forms. The first two pairs of thoracic legs, which are known as gnathopods, are frequently large, specially in the males, and subchelate, the terminal joint being bent back against the penultimate. The last three pairs are generally long and adapted for leaping. The abdominal appendages are biramous and the first three pairs are long and delicate and function as swimming organs. The last three are stouter and assist in leaping and are known as uropods.

To this suborder belong the "beach fleas," which are seen actively skipping around on the sand or hiding, sometimes in great numbers, under debris on the shore. Others are found under stones near tide marks, or burrowing in the sand or living in tubes of their own construction. Still others live in seaweeds or among eelgrass.

They are of considerable economic importance, as they frequently occur in immense numbers and are an important, if not the principal, food of many fishes.

Bate, G. Spence. Catalogue of the Amphipodous Crustacea of the British Museum. Lond. 1862.

Bate & Westwood. British Sessile-eyed Crustacea. Lond. 1863.

Holmes, S. J. Synopses of North American Invertebrates, 18. The Amphipoda. Am. Nat. 1903. 37:267.

Sars's work, mentioned before, is also valuable, as it gives a classification of the group and many figures of species, some of which are found on our shores.

The Amphipoda are divided among three tribes: 1 Hyperiidea, 2 Gammaridea, 3 Caprellidea.

The first of these is purely pelagic or free-swimming and its forms generally possess relatively enormous eyes. Specimens have not been taken within the city limits but they probably occur. By far the greater number of species belong to the second tribe, the third, which is of a distinctly degraded type, being a small one.

2 GAMMARIDEA

According to Sars, this tribe is divided into 25 families and of these 7 have common representatives in New York city.

Family ORCHESTIDAE

Antennulae much shorter than antennae and devoid of a secondary flagellum. Mandibles without a palp. Gnathopods variable, the second pair being generally different in the two sexes. First two pairs of uropoda strong, last pair smaller and one branched.

A very distinct family, the members of which have become more or less adapted to terrestrial life. They may be said to be *the beach fleas*.

Allorchestes dentata (Smith)

Hyalella dentata Smith, S. I. U. S. Fish Com. Rep't. 1872-73. p.645, pl.2, fig.8-10.

A fresh-water form in which the first and second abdominal segments are produced dorsally into spines.

Much the smaller of the two fresh-water Amphipods found within the city. It also differs from *Gammaurus fasciatus*, the

other form, in the lack of a secondary flagellum to the antennulae and in the gnathopoda. The first pair of these are small and sub-

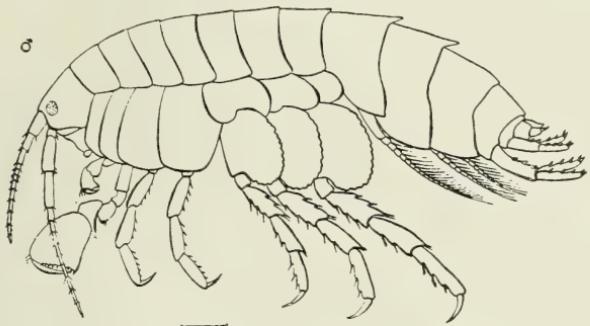


Fig. 19 *Allorchestes dentata* (After Smith)

chelate in both sexes, and the second are small in the female and large in the male.

Length 4.5-6.5 mm.

Occurs in the fresh-water ponds and stagnant pools throughout the city.

***Allorchestes littoralis* Stimpson**

Allorchestes littoralis Stimpson, W. The Marine Invertebrata of Grand Manan. Smithsonian Contributions to Knowledge, 6. Wash. 1854.

Hyale littoralis Verrill. *l. c.* 1874. p.556.

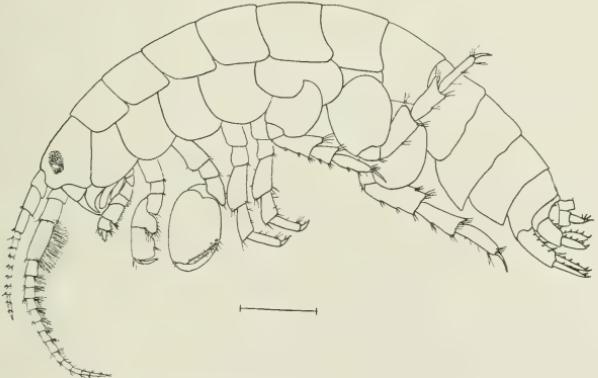


Fig. 20 *Allorchestes littoralis*

Antennae less than one third length of body, much stouter than antennulae and with thick fascicles of hairs. First gnathopoda small, subchelate and alike in both sexes. Second gnathopoda of similar form in both sexes but much larger in the male.

A littoral species, living under stones below high water mark.

Length 8-10 mm. Color green of varying shades to brown. A few specimens were taken on the Chimney Sweeps near City Island.

Orchestia agilis Smith

Orchestia agilis Smith, S. I. In Verrill. *l. c.* 1874. p.555, pl.4, fig.14.

First gnathopods subchelate in both sexes; second pair of male much larger than first, with the hand oval and a notch at the posterior end of the palm. Antennulae not reaching penultimate joint of antennae. Flagellum of antennae stout, shorter than the peduncle

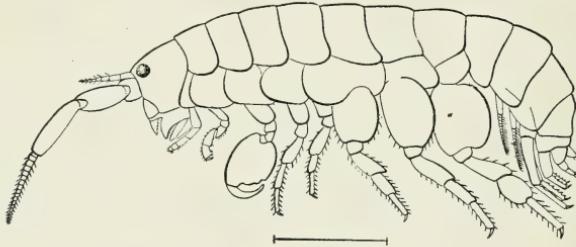


Fig. 21 *Orchestia agilis* (After Verrill)

and with 12-15 segments. First coxal plate small, fifth nearly as deep as fourth and deeply cleft. Carpus of third pereiopod of male swollen.

As its name implies, this is a very active form and it occurs in great numbers under the debris, seaweed, eelgrass etc. cast up by the tide, about high water mark. When this is turned over, they make off by leaps in every direction, so that it is difficult to catch them, and then hide under the edges of stones or other objects.

Length: male 10-15 mm, female 10-14 mm. Color varies greatly, and all shades are found, from a light flesh color through pink or olive green to a deep slate or almost to black.

This species is distributed almost everywhere along the shore of the bays and may nearly always be found.

Orchestia palustris Smith

Orchestia palustris Smith, S. I. In Verrill. *l. c.* 1874. p.555.

Gnathopods as in *O. agilis*, but with palm of second pair of male smooth and without the notch. Antennulae reaching beyond

tip of penultimate joint of antennae. Flagellum of antennae slender, longer than the peduncle and with 18 to 26 segments. Coxal plates as in preceding species.

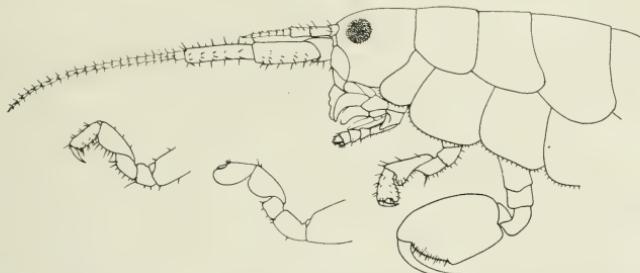


Fig. 22 *Orchestia palustris* male, and first and second gnathopoda of female

Very common under stones and logs above high water mark and somewhat farther from the water than *agilis*.

Length: male 15-22 mm, female 12-18 mm. Color varies much as in *O. agilis*.

Found all along the shores of the bays.

Talorchestia longicornis (Say)

Talitrus longicornis Say, T. l. c. 1818. p. 384.

Talorchestia longicornis Verrill. l. c. 1874. p. 556. Smallwood, M. E. Cold Spring Harbor Monographs, 1. Brooklyn. 1903.

First gnathopods subchelate in the males but not in the females. Second gnathopods of male very large, subchelate, broader distally and with a large tubercle on the palm. Antennulae just reaching tip of penultimate joint of antennae, which are as long as the body. Eyes of moderate size. Coxal plates and uropods much as in *Orchestia*.

Found on the sand beaches between and above tide marks, often running or leaping over the sand but usually buried in it or under driftwood. An exceedingly good account of its habits is given by Smallwood [l. c.] to which the

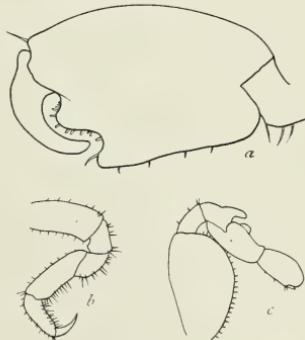


Fig. 23 *Talorchestia longicornis*;
a = second gnathopod of male; b = first and
c = second gnathopod of female

reader is referred. Smallwood is inclined to regard this and the succeeding species as identical, but representing different stages in the life of the animal, those called *longicornis* being the older individuals.

Length 15-25 mm. Color cream or sand-colored, the older specimens showing markings of ocher, brown or violet.

Common on sand beaches.

Talorchestia megalophthalma (White)

Orchestia megalophthalma White. Cat. Crus. Brit. Mus.

Talorchestia megalophthalma Verrill. *l. c.* 1874. p. 556.

Gnathopods as in *T. longicornis*, but palm of male without the tubercle. Antennulae reaching tip of penultimate joint of

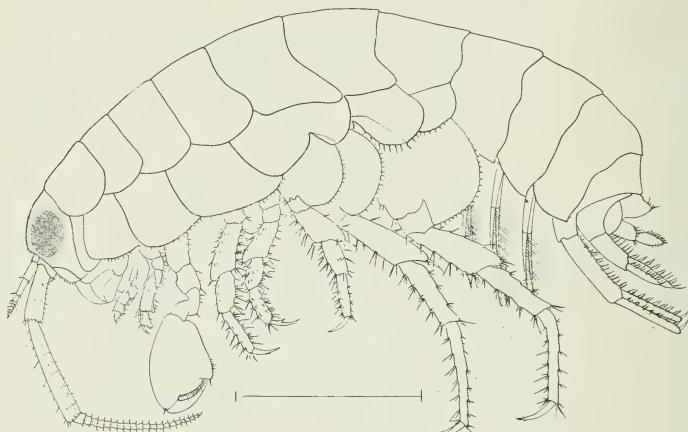


Fig. 24 *Talorchestia megalophthalma*

antennae, which are less than half the length of the body. Eyes very large, occupying greater part of the head.

Habits and color as in the preceding species.

Length 15-25 mm.

Found on sandy beaches.

Family PONTOPOREIIDAE

Antennulae somewhat shorter than antennae and with a secondary flagellum. Mandibles with a palp. Gnathopoda comparatively small and feeble, generally imperfectly subcheliform. Pos-

terior pereiopoda more or less dissimilar in structure and adapted for burrowing in soft bottoms. Uropoda all biramous, the last pair generally unlike the others.

A family which possesses great abilities in burrowing; and the pereiopoda are correspondingly greatly modified. The one species taken probably has the most extreme development in that direction.

Haustorius arenarius (Slab.)

Oniscus arenarius Slabber. *Naturkunde Verlustigingen etc.* p.92, pl.2, fig.3 and 4.

Lepidactylus dytiscus Say, T. l. c. 1818. p.380. Verrill. l. c. 1874, p.556. Smith, S. I. Ct. Acad. Arts and Sci. Trans. 1880. 4:282.

Haustorius arenarius Sars. l. c. 1895. p.135, pl.46.

Antennae with long and plumose hairs. Posterior pereiopoda very broad and without dactylus.

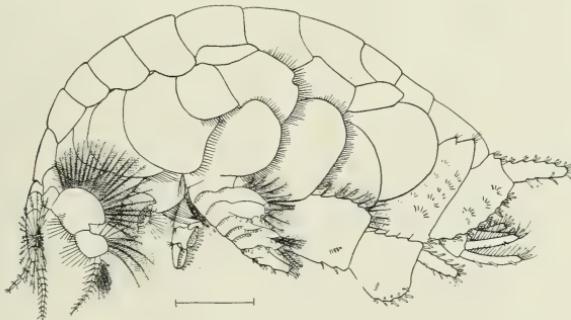


Fig. 25 *Haustorius arenarius*

This species can not be confounded with any other found on our coast. Its peculiar form, in which it somewhat resembles the sand bug, Hippa, and the character of its appendages, cause it to be the most rapid burrower of our coast.

Length 10-12 mm. Cream or sand colored.

Taken at Bayshore and Freeport and will probably be found in the sand along the bays, near high water mark.

Family AMPELISCIDAE

Body compressed anteriorly. Eyes generally four. Antennulae slender, without accessory flagellum, and placed at anterior end of head. Antennae somewhat larger and placed farther back. Last two segments of abdomen fused. Third pereiopoda different from

the preceding, with basal joint large and produced behind into a ciliated lobe.

A burrowing family, only a single species of which has been taken, though others probably occur.

Ampelisca macrocephala Lillg.

Ampelisca macrocephala Lillgeborg. Öfvers. af Kongl. Vet. Akad. Förh. 1852. p.7. Sars. l. c. 1895. p.172, pl.60, fig.1.

Head as long as the first three thoracic segments. Eyes four, small, red and at anterior end of head. Lower posterior angle of the third abdominal segment produced. Basal segment of third pereiopoda nearly transverse below, the carpus not produced anteriorly.

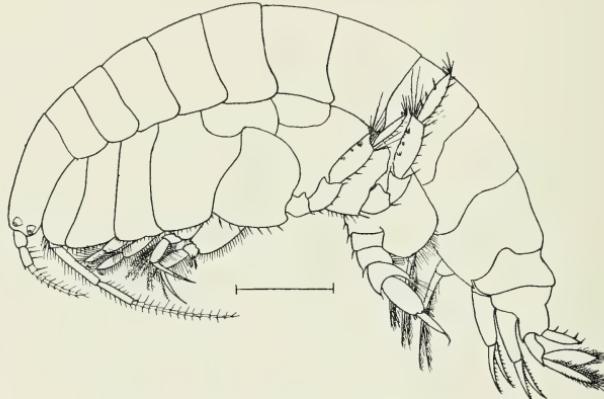


Fig. 26 *Ampelisca macrocephala*

It is a burrowing form, living in smoothly lined tubes, which it constructs in the mud, and in the bottom of which it may generally be found. Length 10-15 mm. Color hyaline white.

Found in the sandy mud flats of Jamaica bay.

Calliopius laeviusculus (Kr.)

Amphithoe laeviusculus Krøyer. Grønlands Amphipoder. Danske Vid-Selsk. Afhandl. 7:281, pl.3, fig.13.

Calliopius laeviusculus Verrill. l. c. 1874. p.557. Sars. l. c. 1895. p.449, pl.158.

Antennulae and antennae subequal, the former without an accessory flagellum but with last peduncular segment produced into a lappet with caceolae. Flagellum of both pairs with many well marked articulations, which give it a serrate appearance. Gnatho-

poda rather large and subchelate. Terminal uropoda slightly larger than preceding, and with rami fringed with hairs and spines.

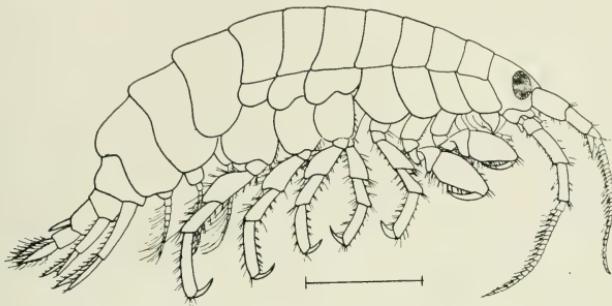


Fig. 27 *Calliopius laeviusculus* (After Sars)

Found, according to Smith, in tidal pools and among algae. Length 10-14 mm. Color light green, whiter dorsally. Taken at South Beach, S. I.

Family GAMMARIDAE

Antennulae and antennae long and slender, the former with an accessory appendage. Mandibles with a palp. Gnathopoda large and subchelate, generally stronger in the male. Pereiopoda more or less slender, the three posterior pairs gradually increasing in length. Terminal uropoda generally projecting beyond the others, biramous and with the rami more or less foliaceous. Telson small and more or less deeply cleft.

Gammarus locusta (Linn.)

Cancer locusta Linnaeus. Fauna Suecica. ed.2. p.497.

Gammarus locusta DeKay. l. c. 1844. p.37. Sars. l. c. 1895. p.499, pl.176.

Antennulae longer than antennae and with flagellum of latter shorter than peduncle. Gnathopoda small and equal in size. Pereiopoda with stiff spines. Last three segments of abdomen with median and lateral fascicles of spines. Third abdominal segment produced. Terminal uropoda with rami subequal and fringed with hairs and spines.

This is a littoral form and is the commonest of our Amphipoda, being found all along the shores of the bays, under stones which are covered at high water. It is not at all at home on land, but,

when the stone is raised, jerks itself along on its sides till it gets under some projecting surface. It is common all along the shores

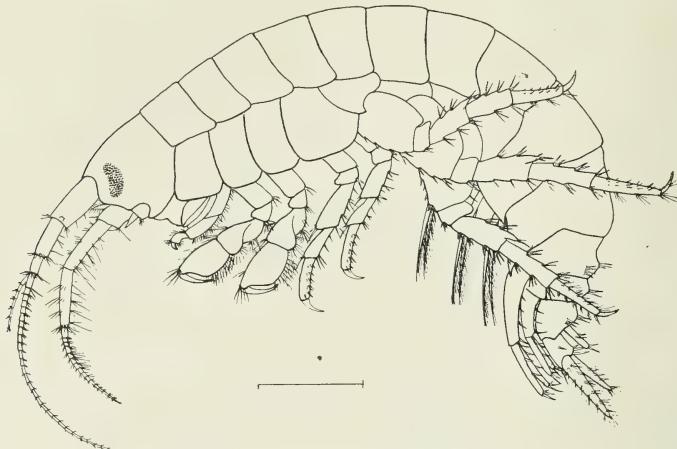


Fig. 28 *Gammarus locusta*

up to the Arctic regions, and farther north attains a larger size than it does here.

Length 10-13 mm. Color green and brown of varying shades.

***Gammarus fasciatus* Say**

Gammarus fasciatus Say, T. l. c. 1818. 1:374. Smith, S. I. U. S. Fish Com. Rep't for 1872-73. 1874. p.653.

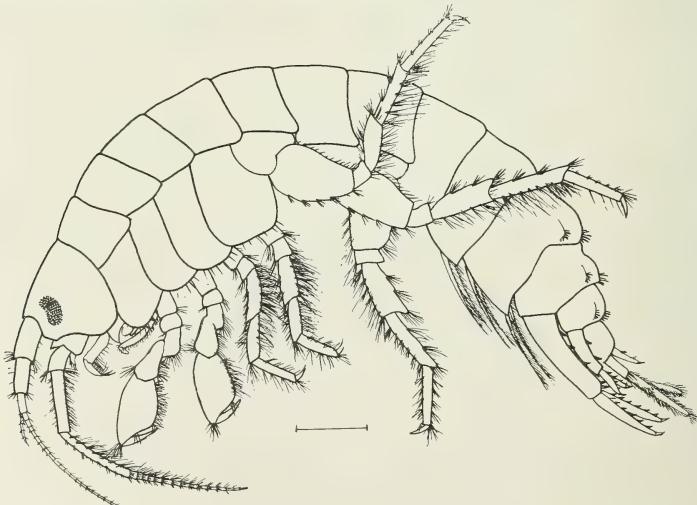


Fig. 29 *Gammarus fasciatus*

A fresh-water form with accessory flagellum on antennulae, and gnathopoda of moderate size in both sexes.

These two points are enough to distinguish this species from the only other fresh-water Amphipod, *Allorchestes dentata*. In addition, the last three segments of the abdomen are armed with median and lateral fascicles of spines, and the terminal uropoda are long and fringed with hairs. Length 10-15 mm. Color white with green markings.

Common in fresh-water ponds among the weeds, and in the brooks under stones.

***Carinogammarus mucronatus* (Say)**

Gammarus mucronatus Say, T. l. c. 1818. p.376. DeKay. l. c. 1844. p.37. Verrill. l. c. 1874. p.559.

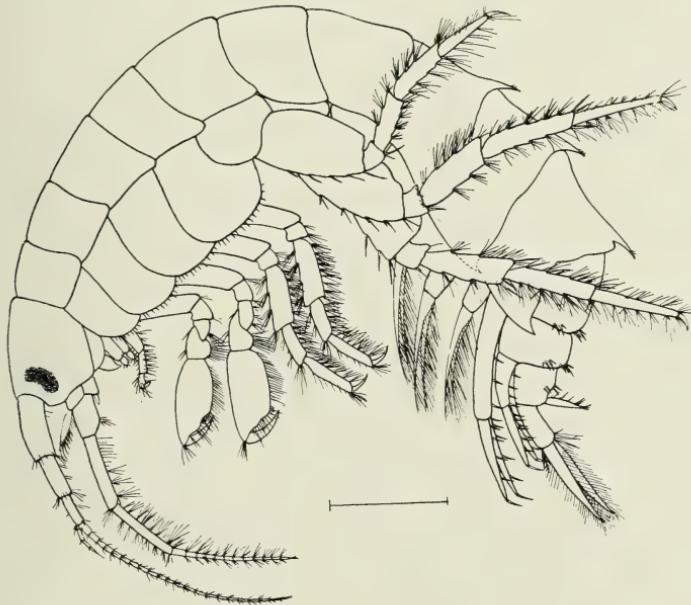


Fig. 30 *Carinogammarus mucronatus*

First three abdominal segments produced dorsally into acute teeth.

The above character will distinguish the present species from all of our other common Amphipoda. The antennulae are about equal in length to the antennae. Gnathopoda of moderate size in both sexes. Lower posterior angle of first three abdominal segments produced and last three furnished dorsally with median and lateral fascicles of spines.

This species lives in the brackish pools and in the marshes, and may be taken on the flats when the tide is out.

Length 15 mm. Color translucent, tinged with green, and with minute black or brown spots. Found all along the shores in suitable localities.

***Melita nitida* Smith**

Melita nitida Smith. In Verrill. *l. c.* 1874. p. 560.

Terminal uropoda with outer branch very elongate, inner branch much reduced. Dorsal part of abdominal segments not produced into teeth. Antennulae longer than antennae and two thirds length

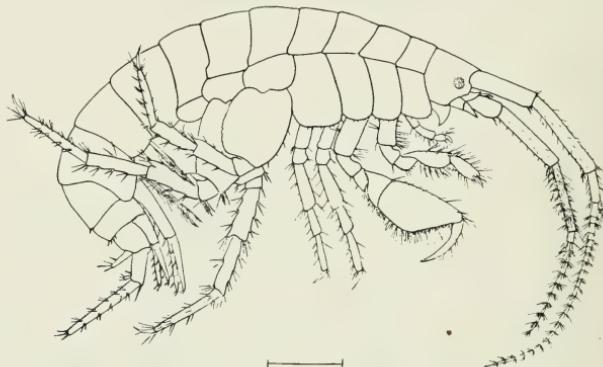


Fig. 31 *Melita nitida*

of body. Flagellum of antennae shorter than peduncle. Eyes round, black. First gnathopoda of male small with the dactyl very minute. Second gnathopoda larger and subchelate. First pereiopoda slightly longer than second; fifth and sixth equal and longer than fourth.

Length 7-9 mm. Color dark greenish slate.

Found but not commonly under rubbish between tides. Taken at Bartow and South Beach, S. I.

A somewhat smaller form probably occurs. This is *M. dentata* (Kr.), and it resembles *nitida* except that the posterior dorsal part of the abdominal segments is produced into small teeth.

***Elasmopus laevis* (Smith)**

Moera laevis Smith. In Verrill. *l. c.* 1874. p. 559.

Last three pereiopoda with joints broad and flat and armed with fascicles of hairs. Antennulae two thirds as long as body, flagellum

as long as peduncle and with accessory flagellum. Antennae as long as peduncle of antennulae. First gnathopoda small, second very much larger.

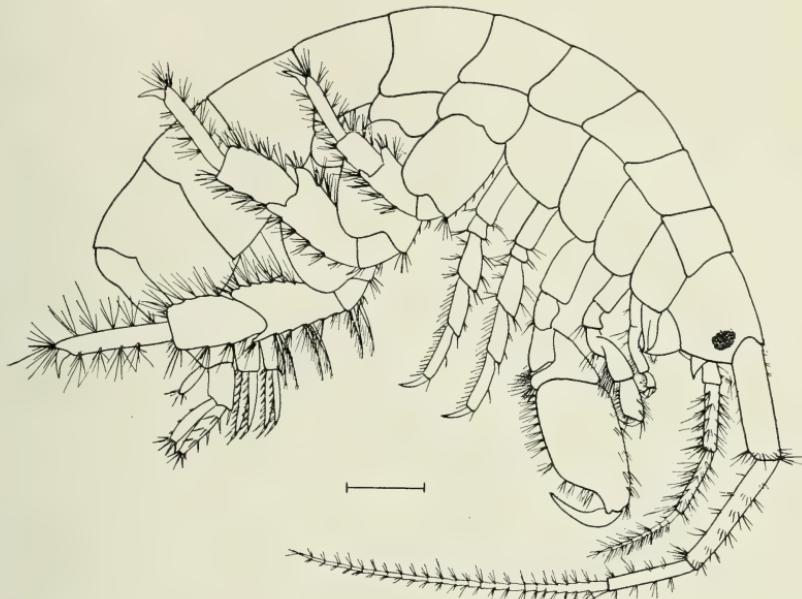


Fig. 32 *Elasmopus laevis*

Length 5-7 mm. Color whitish.

Found under stones and rockweed at low water mark. Taken at Bergen Beach.

Family PHOTIDAE

Antennulae elongated and slender, with or without a secondary flagellum. Antennae usually stouter than antennulae. Mandibles with a palp. Gnathopoda more or less unequal, one of the pairs being peculiarly modified in the male. Last pair of uropoda small and differing from preceding pairs. Telson tubular, receiving end of intestine.

Microdeutopus gryllotalpa Costa

Microdeutopus gryllotalpa Costa. Rend. d. Reale Acad. d. Sc. d. Napoli. 1853. p.178. Sars. l. c. 1895. p.543, pl.192, fig.2.

Antennulae longer than antennae, with secondary flagellum of one joint. Carpus of first gnathopoda of male very large and with three sharp teeth, propodus shorter, irregularly sinuated, dactylus strong, with minute denticulations. First gnathopoda of female

normal. Second gnathopoda of both sexes elongated and with small dactylus. Pereiopoda slender and elongated.

Occurs among hydroids and algae.

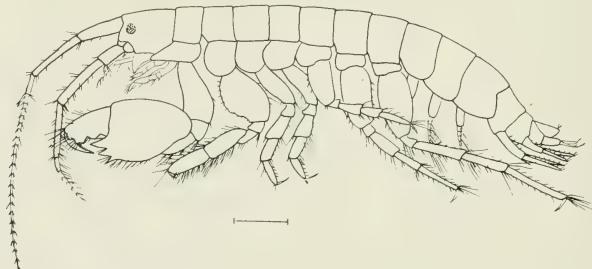


Fig. 33 *Microdeutopus gryllotalpa* (After Sars)

Length 6 mm. Color densely variegated with dark brown.
Taken at Bayshore and at Bartow.

Family PODOCERIDAE

Antennulae elongated, and either with or without a secondary flagellum, and generally smaller than the antennae, specially in the male. Gnathopoda more or less unequal, the posterior ones larger and sometimes enormously developed in the male. Coxae small, fifth pair with the anterior lobe much deeper than the posterior. Terminal uropoda stout, biramous or uniramous, and hooked. Telson small.

This family resembles the preceding, but the hooked terminal uropoda distinguish it.

Amphithoe valida Smith

Amphithoe valida Smith, S. I. In Verrill. *l. c.* 1874. p. 563.

Antennulae without a secondary flagellum, slender and about equal in length to the antennae, and less than half length of body. Flagellum of antennae longer than ultimate joint of peduncle. First gnathopoda with carpus and propodus broad. Second gnathopoda in male with carpus short, propodus large and thick, broadest distally and with palm transverse, and with a broad, low tooth in the middle.

Length 10-13 mm. Color green, with numerous stellate pigment spots.

Found under stones and amid seaweeds and algae on the bottom. Two other species of *Amphithoe* will probably be taken; one, *A. rubricata* (Mont.), has the flagellum of the antennae often

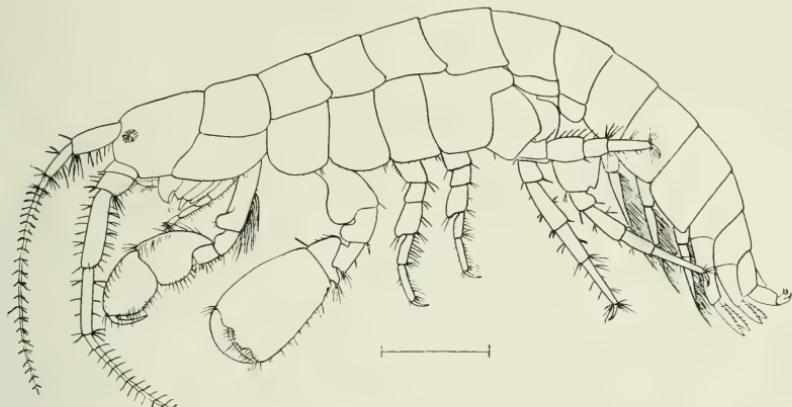


Fig. 34 *Amphithoe valida*

shorter than the ultimate joint of the peduncle, and the palm of the second gnathopoda oblique. In the other form, *A. longimana* Sm., the antennulae are as long as the body and the hands of the gnathopoda are stout and much elongated.

***Jassa marmorata* Holmes**

Jassa marmorata Holmes, S. J. Am. Nat. 1903. 37:289.

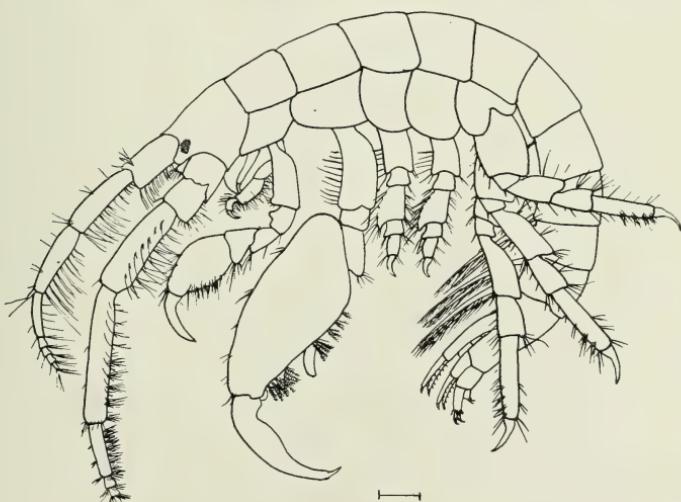


Fig. 35 *Jassa marmorata*, immature male

Antennulae with peduncle longer than flagellum and with secondary flagellum of one joint. Antennae longer and larger than antennulae, with flagellum shorter than ultimate joint of peduncle and with four joints. Gnathopoda of male elongated, the second much larger than the first and with hand very large, and with a stout tooth in the middle of the palm. The specimen figured is immature; the tooth is larger in the adult.

Found among hydroids and seaweeds on piles etc.

Length 5 mm. Color light, variously marked with dark gray.

Taken at Bayshore, in Great South bay and at City Island.

***Unciola irrorata* Say**

Unciola irrorata Say, T. l. c. 1818. 1:389. DeKay. l. c. 1844. p.38.

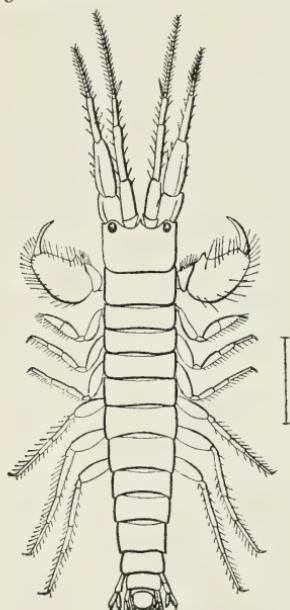


Fig. 36 *Unciola irrorata*
(After Verrill)

Head produced in front into a rostrum. Antennulae with secondary flagellum and longer than antennae, which are stouter and subpediform. First gnathopoda large and subchelate in male, the palm longitudinal and with tooth at inferior end. Second gnathopoda smaller, not chelate, dactyl very small. Posterior limbs small.

A tube-dwelling form, sometimes inhabiting one of its own construction, but usually living in any empty tube it can find. Generally on rocky or shelly bottoms.

Length 10-15 mm. Color variable, light, irregularly spotted with red.

Taken all along the shore.

Family COROPHIIDAE

Body depressed, with abdomen poorly developed. Antennulae with or without a flagellum. Antennae usually much larger and stronger than antennulae and subpediform. Mandibles with palp. Coxal plates small and separated.

All the members of this family inhabit tubes, usually of their own construction, and, together with the preceding family, belong to the old division Domicola.

Corophium cylindricum (Say)

Podocerus cylindricus Say, T. I. c. 1818. 1:387. (Not of Bate. Cat. Amp. Crust. Brit. Mus. 1862. p.256)

Corophium cylindricum Verrill. I. c. 1874. p.566.

Antennulae, relatively to the antennae rather small, with flagellum slender and without secondary flagellum. Antennae of male with penultimate joint of peduncle greatly enlarged and with sharp tooth at distal end. Ultimate joint shorter, flagellum of two joints. Gnathopoda feeble, very similar in both sexes.

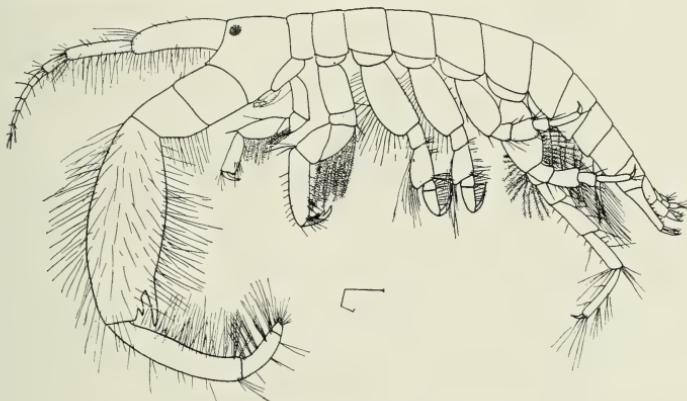


Fig. 37 *Corophium cylindricum*

This species inhabits soft tubes which are found in great numbers in sponges, algae etc. They can easily be obtained by pulling apart the pieces of the red sponge, *Microciona prolifera*, cast up on the beach.

Length 5 mm. Color light, mottled with gray.

Found all along the shore.

3 CAPRELLIDEA

An aberrant tribe which differs from the typical Amphipoda in the form of the body, which is either depressed or cylindric, and in the abdomen, which is rudimentary. It is divided into two families, 1, Caprellidae, cylindric forms, and 2, Cyamidae, or whale lice, which have a flat body. Specimens of the first family only have been taken.

Family CAPRELLIDAE

Amphipoda with a cylindric, flexible body. The head is fused with the first thoracic segment, though the line of fusion is indicated by a suture. There are two pairs of antennae, the first pair the larger. The gnathopoda are subchelate, the second pair much larger than the first. The next two pairs of pereiopoda are wanting in our forms, though present in some genera, but the segments bear lamellar gills and in the female a brood pouch. The three following are the walking legs. Abdomen very small and showing only rudiments of limbs.

The members of this family are usually found clinging to branches of hydroids or seaweeds by their posterior limbs. In their motions they somewhat resemble the larva of the geometrid moths, climbing over the branches by stretching out the body, catching

hold by the anterior limbs and then drawing up the body in a loop. They also have the same habit of holding on by their posterior limbs and stretching their body out straight and stiff. They then resemble very closely the branches of the hydroid, and, as they are of a very similar color, it is difficult to detect them.

Caprella geometrica Say

Caprella geometrica Say, *T. l. c.* 1818, 1:390. DeKay, *T. l. c.* 1844, p.41. Verrill, *T. l. c.* 1874, p.567, pl.5, fig.20.

Head with a horizontally projecting spine. Mandibles without a palp. Body smooth and with short thick segments.

Length 8-10 mm. Color variable, usually resembling the object on which it is found.

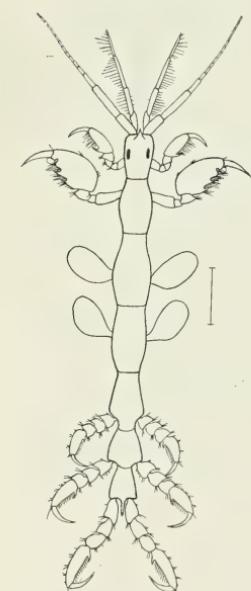
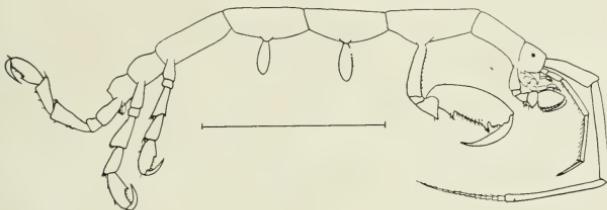


Fig. 38 *Caprella geometrica*

Taken at South Beach S. I. on hydroids and algae on underside of stones.

Aeginella longicornis Kr.*Aeginella longicornis* Kroyer.

Antennulae elongate, more than twice as long as antennae. Mandibles with a palp. Second gnathopoda with two large teeth on the palm. Body either smooth or thickly covered with short slender spines.

Fig. 39 *Aeginella longicornis*

Length 10-25 mm. Color variable.

Large specimens taken among hydroids in Great South bay. Smaller ones were taken all along the bays among hydroids and algae.

Suborder *b* ISOPODA

Arthrostraca with body flattened dorso-ventrally instead of laterally. The gills are borne on the abdominal appendages.

The antennulae and antennae are much as in the Amphipoda, the former with a peduncle of three, and the latter of five segments, and a flagellum. Eyes composed of groups of ocelli and nearly always sessile. The first thoracic appendage is a maxilliped, and the next seven (occasionally only six) are walking legs and usually all alike, whence the name Isopoda, or equal-footed. A part of the basal joint, or coxa, of the leg is fused with the dorsal part of the body and is known as the epimeron. A suture, known as the epimeral suture, usually shows the line of fusion. The abdominal segments are smaller than the thoracic and are frequently more or less united. The first five bear delicate lamellar appendages which function as breathing organs and the last pair are modified into uropoda.

Though not a large group, the members of the Isopoda are probably more widely distributed than any other of the Crustacea.

They are found under rocks and logs on the shore, or burrowing in the sand or in timber. Other forms are pelagic or cling to floating seaweeds, eelgrass or the hydroids on piles. Many forms are parasitic. Some are found in fresh water and still others, probably the most familiar to the casual observer and known as sow-bugs or pill-bugs, are found under stones on land or under bark.

The principal paper on the marine Isopoda is by Harger, "Report on the Marine Isopoda of New England and Adjacent Waters," *U. S. Fish Com. Report for 1878*, Washington, 1880. This contains descriptions and figures of most of the species mentioned in the following.

A key to the Isopoda of North America was published by Harriet Richardson in the *American Naturalist*, 1900, 34: 207-30, 295-309. This was incorporated in the "Key to the Isopods of the Atlantic Coast of North America, with Descriptions of New and Little Known Species," by the same author and published in *Proc. of the U. S. Nat. Mus. 1901*, 23: 493-579. A bibliography of American forms is there given.

Say's work mentioned before [p. 125] gives descriptions of several of our forms; and Sars, in the *Crustacea of Norway*, figures several cosmopolitan species which occur here. References to Verrell's *Invertebrates of Vineyard Sound* are also given.

I CHELIFERA

Distinguished from all other Isopoda by the first pair of legs or gnathopoda being chelate. Pleopoda when present, natatory. Uropoda terminal, with a short basal part and one or two terminal filaments. Respiration thoracic.

A very anomalous group which differs in several respects from the typical Isopoda and by some authors has been entirely removed from the order. Divided into two families, of which one is represented. 1 Tanaidae, 2 Apseudidae.

Family TANAIDAE

Body cylindric. Antennulae close together, short in female, much longer in male, with minute rudiment of a flagellum and without secondary flagellum. Antennae shorter with flagellum generally biarticulate. Uropoda short.

Leptochila dubia (Kr.)

Tanais dubius Krøyer. Nat. Tidsskr. 4:178, pl.2, fig.20-22.
Tanais filum Verrill. l. c. 1874. p.573.
Leptochila algicola Harger. l. c. 1880. p.421, pl.12-13, fig.80, 83-86.

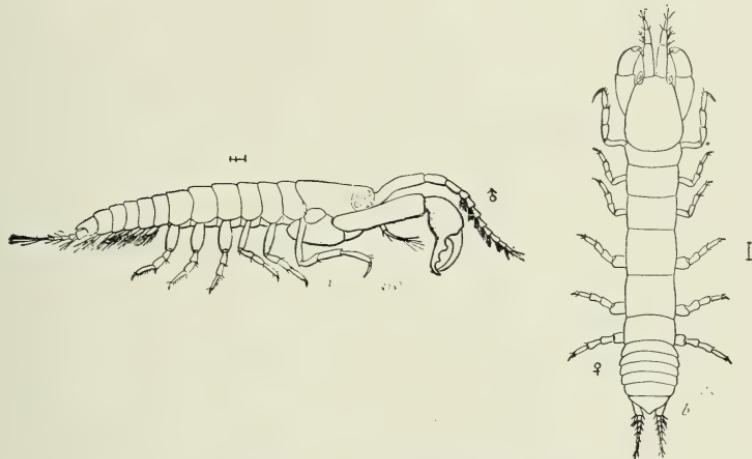


Fig. 40 *Leptochila dubia* a, male; b, female (After Harger)

Pereion with six segments. Gnathopoda stout, uropoda with short, one jointed outer, and a six jointed inner ramus. Female with antennulae and gnathopoda shorter than in male.

Occurs among eelgrass and on piles.

Length 2.2 mm. Color nearly white.

Taken at Bayshore.

Leptochila rapax Harger

Leptochila rapax Harger. l. c. 1880. p.424, pl.13, fig.89-90.

Pereion with six segments. Gnathopoda of male very slender and elongated. Inner ramus of uropoda five jointed. Female very similar to *L. dubia*, but the five jointed uropoda will distinguish it.

A tube-inhabiting form, living in the mud.

Length: male 2.6-3.8 mm, female 2.3 mm.
 Color white.

Taken at Bayshore.

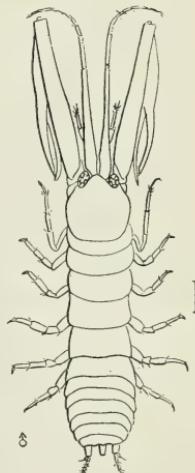


Fig. 41 *Leptochila rapax* male (After Harger)

2 FLABELLIFERA

Uropoda lateral, forming with the last segment, a tail fin. Pleopoda generally of the character of swimming organs, though serving partly for respiration.

A group of Isopoda exhibiting very diverse characters. It is divided into 11 families, of which 3 have common representatives.

Family ANTHURIDAE

Body cylindric, narrow and elongated. Uropoda lateral and superior, outer branch arching over base of telson.

Cyathura carinata (Kr.)

Anthura carinata Krøyer. Nat. Tidsskr. (2). 2:402.

? *Anthura gracilis* DeKay. l. c. 1844. p.44, pl.9, fig.34.

Anthura brunnea Verrill. l. c. 1874. p.572.

Anthura polita Harger. l. c. 1880. p.398, pl.11, fig.68-69.

Cyathura carinata Richardson. l. c. 1901. p.508.

Segments of the pleon fused so as to resemble an eighth thoracic segment. Terminal uropoda bent so as to resemble a cup or "flower". Antennulae and antennae similar, short and stout, with very small flagellum. A bottom form living in sand and mud.

Length 15-18 mm, breadth 1.8-2 mm. Color brownish, mottled with yellow.

Taken at Bergen Beach on sand flats.

A somewhat similar species, *Anthura tenuis* (Harger) may possibly be found in the same localities. It is smaller than the above, measuring 11 mm, and the antennulae of the male are very hairy, resembling bottle brushes.

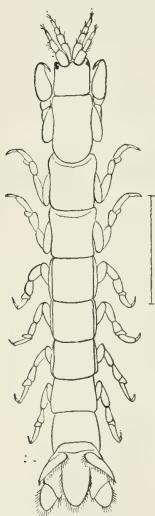


Fig. 42 *Cyathura carinata* (After Harger)

Family CYMOTHOIDAE

Parasitic, usually on fish. Head projecting over base of antennulae, which, like the antennae are short and tapering with but little distinction into peduncle and flagellum. Dactylus of feet curved and adapted for fastening to the body of the fish.

Aegathoa loliginea Harger

Aegathoa loliginea Harger. Am. Jour. Sci. Ser. 3, 1878. 15:376.
Harger. l. c. 1880. p.393, pl.10, fig.66. Richardson. l. c. 1901. p.526.

Front of head evenly rounded, eyes very large. Antennae 10 jointed. First thoracic segment longer than others, which are equal in length. Legs armed with strong curved claws. Pleon long and large, uropoda slightly ciliated. (The uropoda in the specimens taken were like the right uropod in the figure.)

Parasitic in the mouth of the squid usually, but taken on bluefish in Great South bay.

Length 13 mm, breadth 3.6 mm. Color in alcohol, yellow with minute black spots.

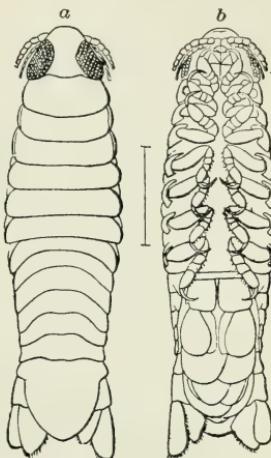


Fig. 43 *Aegathoa loliginea*
(After Harger)

Livoneca ovalis (Say)

Cymothoa ovalis Say, T. l. c. 1818. 1:394.
Cymothoa triloba DeKay. l. c. 1844. p.46, pl.10, fig.40.
Livoneca ovalis Verrill. l. c. 1874. p.572. Harger. l. c. 1880. p.395.
Richardson. l. c. 1901. p.531.

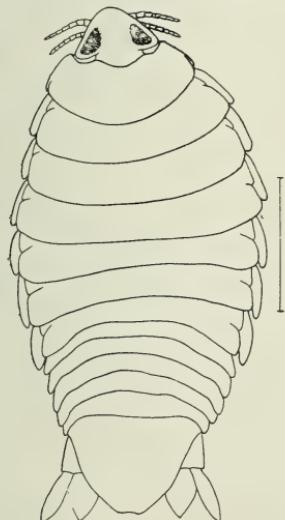


Fig. 44 *Livoneca ovalis*

A parasitic Isopod, with body broadly oval and more or less distorted. Dorsal surface moderately convex. Feet pressed closely to the body and concealed; the first three pairs pointing forward, the last four backward.

They are found clinging to the roof of the mouth or to the gills of fishes. The bluefish is the usual host, but it occurs on other forms, such as the scup.

Length 15-22 mm, breadth 10-12 mm. Color light with minute, short, dark lines, which may be numerous enough to give the animal a very deep color.

Family SPHAEROMIDAE

Body short and convex. Head broad and transverse. Antennulae and antennae multiarticulate and distinctly divided into peduncle and flagellum. Anterior segments of pleon short with segments united.

Cassidina lunifrons Richardson

Cassidina lunifrons Richardson. Am. Nat. 1900. 34:222. U. S. Nat. Mus. Proc. 1901. 23:533. fig.14.

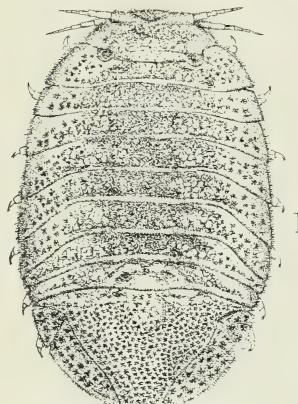


Fig. 45 *Cassidina lunifrons*

A small species with broad, elliptic body. Head broader than long and set into thorax, eyes at posterior lateral corners. Terminal segment large and truncate. Inner branch of uropoda pointed and reaching tip of abdomen, outer branch one fourth longer than inner. Legs short and equal.

Found below high water mark in muddy situations, clinging to the underside of boards and bark. Usually covered with mud so that its color can not be recognized.

Length 1 mm. Color yellowish brown with many small, dark brown and blackish spots.

Taken at Bartow and at Fresh Kills, S. I.

Sphaeroma quadridentatum Say

Sphaeroma quadridentatum Say, T. Acad. Nat. Sci. Phila. Jour. 1818. 1:400. Verrill. l. c. 1874. p.569. Harger. l. c. 1880. p.368, pl.9, fig.53-54. Richardson. l. c. 1901. p.533.

A littoral form which may be distinguished from other marine Isopoda by its habit of rolling itself up into a round ball when disturbed, like the land "pill-bugs". Body broad and elliptic. Terminal segment rounded, branches of uropoda subequal and extending beyond tip of terminal segment.

Found on the underside of rocks, between tides.

Length 8 mm, breadth 4 mm. Color very variable, some slaty gray or marked on the back with a whitish, cream-colored or rosaceous longitudinal patch bordered more or less with black. The color is evidently protective, as it matches closely the rocks on which the animals are found.

Taken at Bartow. Another smaller species, as yet undescribed, and apparently belonging to this genus, has been found swimming around in the small pools left by the tide, at City Island and on Staten Island.

3 VALVIFERA

Uropoda ventral, arching over and protecting the pleopoda, which are delicate and mostly branchial in character.

Of the three families one is represented.

Family IDOTEIDAE

Antennulae of four segments, the basal segment enlarged and the terminal one clavate.

Pleon with more or fewer of its segments consolidated into a scutiform tail-piece.

Idotea marina (Linn.)

Oniscus marinus Linnaeus. Fauna Suecica. 1761. p.500.

Stenosoma irrorata DeKay. l. c. 1844. p.43, pl.10, fig.42.

Idotea irrorata Verrill. l. c. 1874. p.569, pl.5, fig.23. Harger. l. c. 1880. p.343, pl.5, fig.24-26.

Idotea marina Richardson. l. c. 1901. p.540.

Body with sides nearly parallel. Antennulae short, of four segments. Antennae longer, with multiarticulate

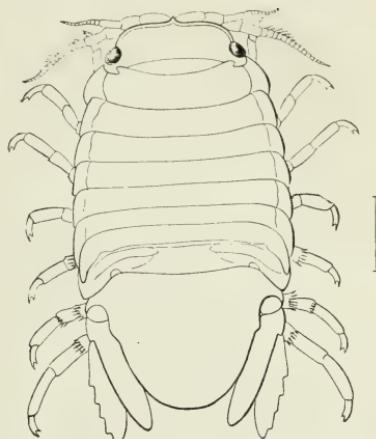


Fig. 46 *Sphaeroma quadridentatum* (After Harger)

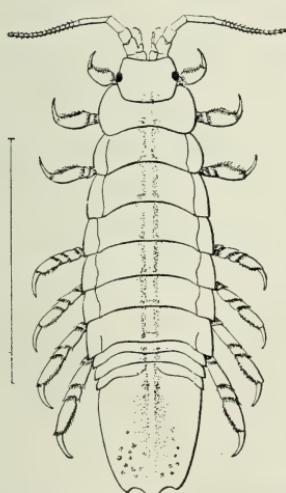


Fig. 47 *Idotea marina* (After Harger)

flagellum longer than peduncle. Pleon apparently consisting of four segments, the first three short, the last long and tridentate. Length: males 30-36 mm, breadth 8-9 mm; female smaller, rarely exceeding 20 mm.

Color very variable, frequently a uniform light or dark green or brownish with minute black punctations. Very often there is a dorsal stripe. Rarely the colors are arranged in transverse bands and blotches. Females usually darker than males, often with a light lateral stripe.

Found on the seaweed on rocky shores or in eelgrass where its color is protective. Sometimes found far from land on floating seaweed. Common all along the shore.

***Idotea phosphorea* Harger**

Idotea phosphorea Harger. U. S. Com. of Fish and Fisheries. Rep't. 1874. p.569 (275). *I. c.* 1880. p.347, pl.5, fig.27-29. Richardson. *I. c.* 1901. p.541.

Body with sides parallel. Antennulae short, of four segments. Antennae longer, with multiarticulate flagellum, which is shorter and stouter than in preceding species. Pleon apparently consisting of four segments, the first three short, the last pointed.

The young of this species resemble the young of the preceding, but may be distinguished by the epimeral sutures not crossing entirely the second and following segments.

Length 25 mm, breadth 7 mm. Color varied, dark green or brownish with patches of yellow or whitish, not striped as in *I. marina*.

Found among the rocks and seaweed along with the last, but much more rarely, being a more northern form. Small specimens taken at South Beach, S. I.

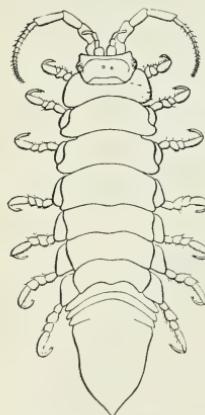


Fig. 48 *Idotea phosphorea* (After Harger)

Another species, *Idotea metallica* Bosc, (*I. robusta* of Verrill and Harger) will probably be taken. It may be distinguished by the truncate terminal abdominal segment.

Edotea triloba (Say)

Idotea triloba Say, T. Acad. Nat. Sci. Phila. Jour. 1818. 1:425.
Epelys trilobus Verrill. l. c. 1874. p.571. Harger. l. c. 1880.
 p.358, pl.7, fig.42-43.

Idotea triloba Richardson. l. c. 1901. p.545.

Body flat, elongated in form and the lateral edges of the segments smoothly rounded. A depressed line runs from the posterior lateral angles of the head across all the segments to the pleon. Pleon consisting of a single piece pointed at the end. Antennulae and antennae short.

Length 6 mm, breadth 2.3 mm. Color uniform, dull.

Found under stones or creeping over the bottoms or amidst and beneath the decaying vegetable matter in sheltered situations.

Taken on eastern shore of Staten Island.

4 ASELLOTA

Segments of pleon fused into a shieldlike plate. Pleopoda exclusively branchial and reduced in number. Uropoda terminal as in Chelifera and biramous. Antennulae small, antennae sometimes very large. Five families, two represented.

Family ASELLIDAE

Mainly fresh-water forms, distinguished by the pleopoda, which number in the female four pairs, the first very small and not operculiform, the rest biramous, the second pair forming an operculum for the last two. In the male there are five pairs, an additional pair, the copulatory appendages, being interposed between the first and second pairs.

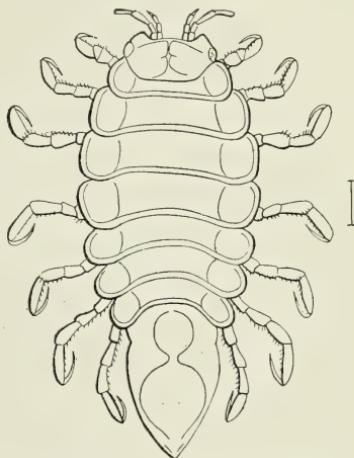


Fig. 49 *Edotea triloba* (After Harger)

Asellus communis Say

Asellus communis Say, T. l. c. 1818. p.427. DeKay. l. c. 1844. p.49. Smith, S. I. U. S. Fish Com. Rep't for 1872-73. 1874. p.657, pl.1, fig.4. Richardson. l. c. 1901. p.551.

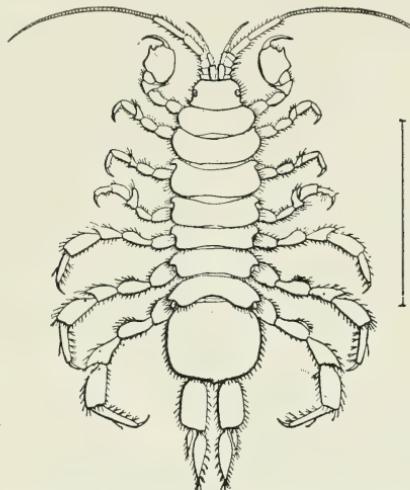


Fig. 50 *Asellus communis* (After Smith)

A fresh-water form. Body with sides parallel. Antennulae short and flagellum with several segments. Antennae more than half length of body. First pair of legs of male chelate, last three pairs longer than the preceding. Pleon large, squarish and in one piece; uropoda elongated and flattened.

Length 15 mm, breadth 5 mm. Color brown, spotted and mottled with yellowish.

The only fresh-water Isopod found in New York city. Occurs under stones in brooks and ponds everywhere.

Family JANIRIDAE

Marine forms, much like Asellidae. The first pair of pleopoda in the female are a large opercular plate. To the corresponding plate of the male the copulatory appendages are joined laterally, succeeding pairs delicate.

Jaera marina (Fab.)

Oniscus marinus Fabricius. Fauna Grönlandica. p.252.

Jaera copiosa Verrill. l. c. 1874. p.571.

Jaera albifrons Harger. l. c. 1880. p.315, pl.1, fig.4-8.

Jaera marina Richardson. l. c. 1901. p.554.

Body oval, slightly more than twice as long as broad. Antennulae short, antennae more than half the length of body and with multiarticulate flagellum. Pleon in one piece, semicircular, with short uropoda rising from a notch in the end.

Length 5 mm, breadth 2 mm, males about one third shorter and somewhat narrower. Color very variable, slaty gray with blotches

of yellow and reddish brown. Some are light colored or nearly white, often with two or more transverse bands, forming a striking looking animal. Very frequently also shades of light or dark green occur, and the incubatory lamellae of the female are often bright green.

Very common all along the shore below high tide on rocks under seaweeds where their color is protective, or clinging to the undersides of stones or boards. Frequently found in the little pools left on the rocks by the tide.

Found commonly all along the coast.

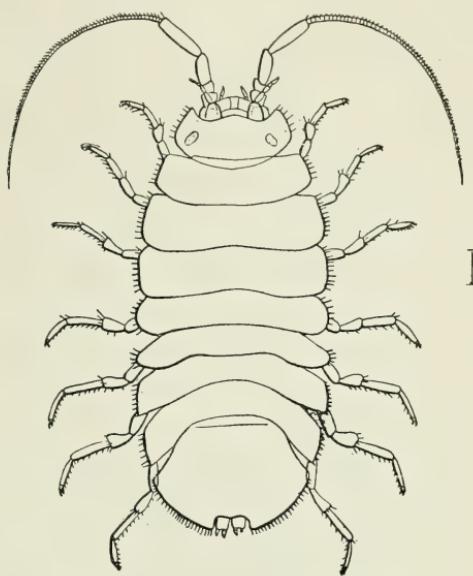


Fig. 51 *Jaera marina* (After Harger)

5 ONISCOIDEA

The tribe Oniscoidea is almost unique among Crustacea in being entirely terrestrial, even the early stages being passed on land. They are oval forms with a more or less depressed body, and the fused head and first thoracic segment are sunk in the second. The first antennae are very small, three-jointed and placed on the front of the head. The second antennae are long and consist of a peduncle of five, and a flagellum of two or three segments.

They breathe by lamellar gills which are processes of the abdominal limbs, and in consequence they require a rather damp atmosphere.

Their colors are usually dull, brown or dark gray being the prevailing tones; but they are very variable, even in the same species, and color is not to be relied on as a means of identification. In fact a large number of species have been described at various times with color as their main specific character, and many of them have had to be thrown out.

They are more or less gregarious and are found, frequently in considerable numbers, in damp situations, as under logs and stones which have lain on the ground for some time, or under bark or in crevices of trees or in moss.

Many of the species are world-wide in distribution, and a number seem to prefer the vicinity of human habitations, old greenhouses being a favorite resort.

They are commonly known as sow-bugs, pill-bugs, wood lice or slaters and are probably familiar to everyone. In spite, however, of their commonness, little appears to be known of their habits. According to Fitch, their only economic value is as a food for fowls; but in former times they found much favor as a medicinal agent, being used either dried and pulverized or made into an infusion with "Rhenish wine."

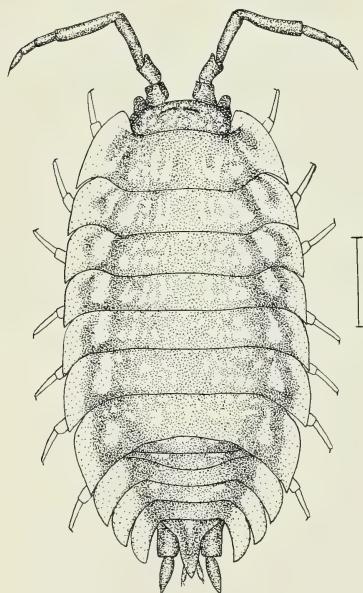


Fig. 52 *Oniscus asellus*

This and the following species differ from all the rest of our terrestrial Isopods in having the flagellum of the antennae with three joints instead of two. From *Philoscia* it differs in the greater size and in the lateral angles of the head under the eyes being produced into lobes.

Family ONISCIDAE

Antennæ generally long. Body not usually able to be contracted into a ball. Uropoda long and reaching beyond terminal segment, which is generally conically produced.

Oniscus asellus Linn.

Oniscus asellus Linnaeus.
Fauna Suecica, ed.2, p.500. DeKay.
l. c. 1844. p.51, pl.6, fig.12. Sars.
l. c. 1899. v.2, p.171, pl.75. Richardson.
l. c. 1901. p.562.

Flagellum of antennæ three jointed; head produced under eyes.

This and the following species

Length 12-18 mm. Color deep slate, the lamellar edges white and a row of white spots within the edge.

Found under the bark of dead trees or under logs and stones and in greenhouses. Occurs all over the city.

Philoscia vittata Say

Philoscia vittata Say. *l. c.* 1818. p.429. DeKay. *l. c.* 1844. p.50. Harger. *l. c.* 1880. p.306, pl.1, fig.1. Richardson. *l. c.* 1901. p.565.

Flagellum of antennae three jointed; head rounded.

A much smaller species than the preceding, from which it differs in the lack of the projections under the eyes. The abdominal segments are narrower in comparison with the thoracic than in the other terrestrial forms.

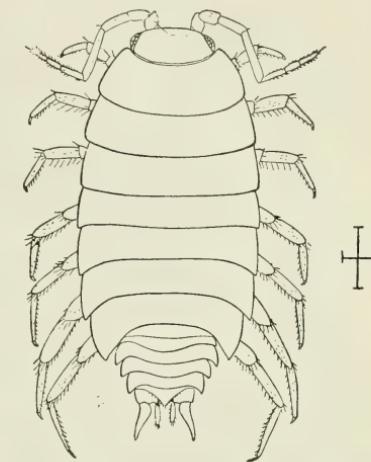


Fig. 53 *Philoscia vittata* (After Harger)

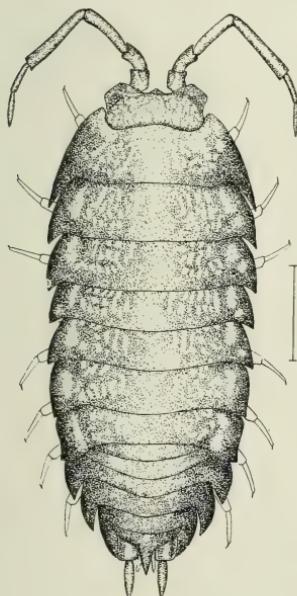


Fig. 54 *Cylisticus convexus*

Length 8 mm, breadth 4 mm. Color variable, usually brownish with two darker streaks along the median line.

This species is said by Say to be "very common under stones, wood etc. in moist situations," but according to Harger it occurs near the shore under rubbish. The only specimens taken by the writer were found at Freeport L. I., in April, where they were abundant on the underside of boards above high water.

Cylisticus convexus (DeGeer)

Oniscus convexus DeGeer. *Mém. des Insectes.* 7:553, pl.35, fig.11.

Cylisticus convexus Budde-Lunde. *Crust. Isop. Terrestria.* 1885. p.77-79. Sars. *l. c.* 1899. 2:186, pl.81. Richardson. *l. c.* 1901. p.566.

Body very convex and smooth, capable of being rolled into a round ball. Uropoda long and pointed.

This species, like *Armadillidium*, has the habit of rolling itself into a ball when handled or disturbed, and they have thus obtained the name pill-bugs. From *Armadillidium* it differs in having long and pointed uropoda. From the rest of the *Oniscoidea* it differs in its convex and more elongated form and its ability to form a ball. The body also lacks the tubercles usually found in the genus *Porcellio*.

Length 10-12 mm. Color chocolate brown or dark gray with a submarginal row of white spots, within which is a large mass of smaller, irregular markings. No median stripe. The markings of this species are fairly constant.

It is rather rapid in its movements, running off and hiding under any sheltering object. If handled it rolls itself up into a very perfect ball and is difficult to distinguish from pebbles. Found in woods under logs or along roads under stones, usually in rather dry situations.

Common all over the city.

***Porcellio rathkei* Brandt**

Porcellio rathkei Brandt.
Bul. de la Soc. Imp. d. Naturalistes
de Moscou 1833. 6:15. Sars. l. c.
1899. 2:180, pl.79. Richardson. l. c.
1901. p.567.

Joints of flagellum of antennae subequal, color variable but usually with median and lateral stripes.

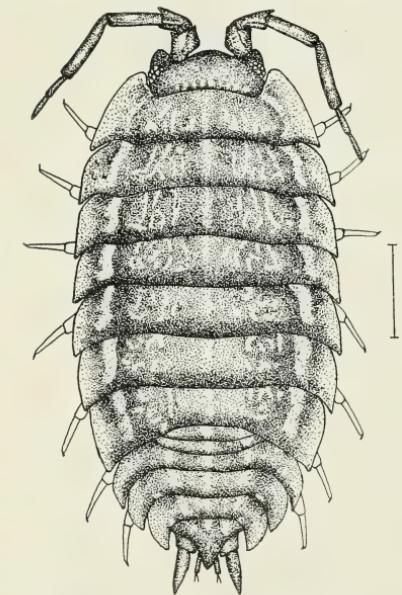


Fig. 55 *Porcellio rathkei*

The commonest as well as the most variable of our terrestrial Isopoda. In form it is only moderately convex, and the dorsal surface is covered with small tubercles. The front is smoothly rounded, and the uropoda are moderately long.

Length 10-12 mm. Color brown, with two lateral, and usually a median light stripe. Besides these, there are two rows of markings which are very variable, sometimes being long and sinuous and sometimes merely irregular blotches. In some specimens all traces of a regular pattern disappear, and the body is covered with a mass of irregular brown, black and white spots.

Very common under stones, boards etc. everywhere in the city.

Porcellio scaber Latreille

Porcellio scaber Latreille.
Hist. Nat. des Crus. et des Insectes.
7:45. Sars. l. c. 1899. 2:176, pl.77. Richardson.
l. c. 1901. p.568.

Tubercles large and numerous, color nearly uniform.

In this species the entire body is covered with tubercles which are specially large on the head. The lobes under the eyes are well developed, and the front is slightly produced. The terminal joint of the antenna is slightly shorter than the preceding.

Length 12-15 mm. Color generally a uniform black or very dark gray, with traces occasionally of two lateral rows or markings.

Found under stones, logs or bark in rather dry situations. Occurs all over the city but not commonly.

Metaponorthus pruinosus (Brandt)

Porcellio pruinosus Brandt. Bul. de la Soc. Imp. d. Naturalistes de Moscou. p.19.

Metaponorthus pruinosus Sars. l. c. 1899. 2:184, pl.8, fig.2. Richardson. l. c. 1901. p.569.

Lateral lobes of head small, front nearly straight; body smooth and flattened.

A small species somewhat resembling in form and in the narrow abdomen *Philoscia vittata*, from which it may be distin-

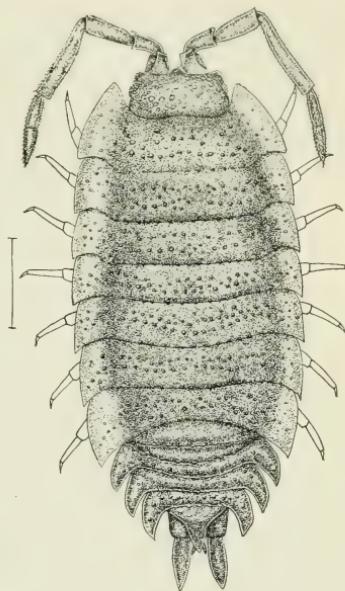


Fig. 56 *Porcellio scaber*

guished by the biarticulate flagellum of the antennae. It differs from *Porcellio* in the smallness of the lateral lobes of the head

and in the absence of any projection between the eyes. Antennae long and delicate. Integument soft and thin.

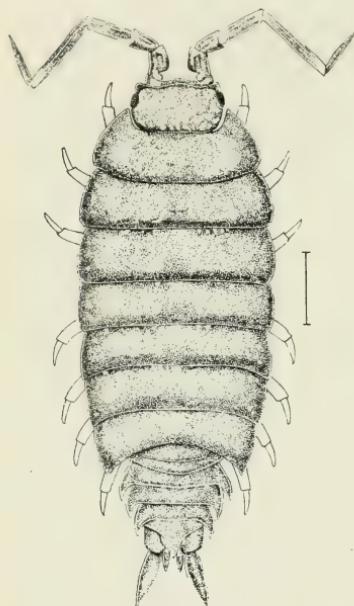


Fig. 57 *Metaponorthus pruinosus*

Length 8-12 mm. The color of living animals is silvery, but in alcohol it is brown with irregular lighter spots and streaks. The antennae are distinctly banded, the distal portion of each joint being lighter than the base.

They are very active forms and are what might be called domesticated, being found in greenhouses or along walls, usually under decaying vegetable matter.

Found all over the city.

Family ARMADILLIDIDAE

Antennae generally short. Body able to be contracted into a ball. Uropoda not reaching beyond terminal segment, which is short and broad.

Armadillidium vulgare (Latreille)

Armadillo vulgare Latreille. Hist. Nat. des Crus. et des Insectes. 7:48. DeKay. l. c. 1844. p.5.

Armadillidium vulgare Richardson. l. c. 1901. p.574.

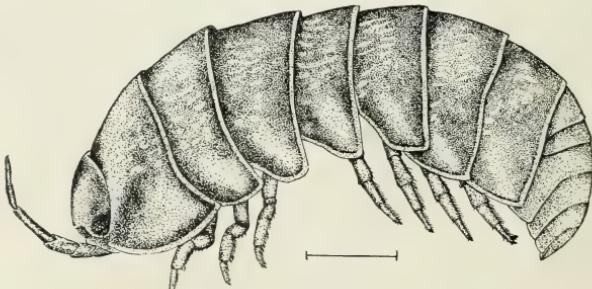


Fig. 58 *Armadillidium vulgare*

Body very convex and capable of being rolled into a ball. Uropoda short.

Another form which, like *Cyclisticus*, can roll itself into a perfect ball, and is thus known as a pill-bug. From that and all of our other terrestrial Isopoda it differs in the shape of the terminal uropoda, which are short and do not extend beyond the edges of the adjoining segments. Antennae short. Integument thick and heavy.

Length 10-12 mm. Color dark gray or nearly black with rows of indistinct, irregular spots.

Not very common, but specimens have been taken at Bayshore, and it will probably be taken within the city limits. Occurs under stones and boards.

EPICARIDEA

Forms which, as their names indicate, are parasitic on other Crustacea. Owing to their mode of life, their structure is very much modified and degraded, the extent to which it is carried varying in the different species. The males are relatively to the females very small and are found clinging to the body of the female. Of the four families one, the least degenerate, is represented.

Family BOPYRIDAE

Body of female distinctly segmented, asymmetric and flattened dorsally. Male more slender and symmetric.

Parasitic on decapodous Crustacea.

Probopyrus palaemoneticola (Packard)

Bopyrus palaemoneticola Packard. Zoology for High Schools and Colleges. 1881. p.289.

Bopyrus sp. Harger. *I. c.* 1880. p.312.

Probopyrus palaemoneticola Richardson. U. S. Nat. Mus. Proc. 1904. 27:66, fig.41-43.

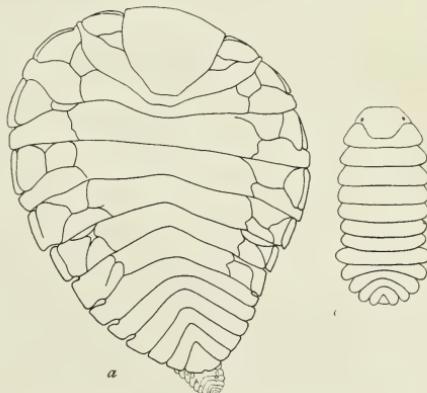


Fig. 59. *Probopyrus palaemoneticola*: a = female with attached male, b = male.

Found under the carapace of *Palaemonetes vulgaris*, where it produces large tumors.

The female is eyeless and somewhat distorted and lies with the flattened dorsal region against the body of the host. The ventral side consists mainly of a large incubatory pouch filled with eggs. Male very small, with eyes, and usually to be found clinging to the female as in the figure.

Length of female 5 mm. Color white with black markings.

Found on the Palaemonetes along the shore.

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Geologist's annual reports 1881-date. Rep'ts 1, 3-13, 17-date, O; 2, 14-16, Q.

The annual reports of the early natural history survey, 1837-41, are out of print.

Reports 1-4, 1881-84, were published only in separate form. Of the 5th report 4 pages were reprinted in the 39th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891) and 13th (1893) are omitted from the 45th and 47th museum reports.

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In 1898 the paleontologic work of the State was made distinct from the geologic and was reported separately from 1899-1903. The two departments were reunited in 1904.

Paleontologist's annual reports 1899-1903.

See fourth note under Geologist's annual reports.

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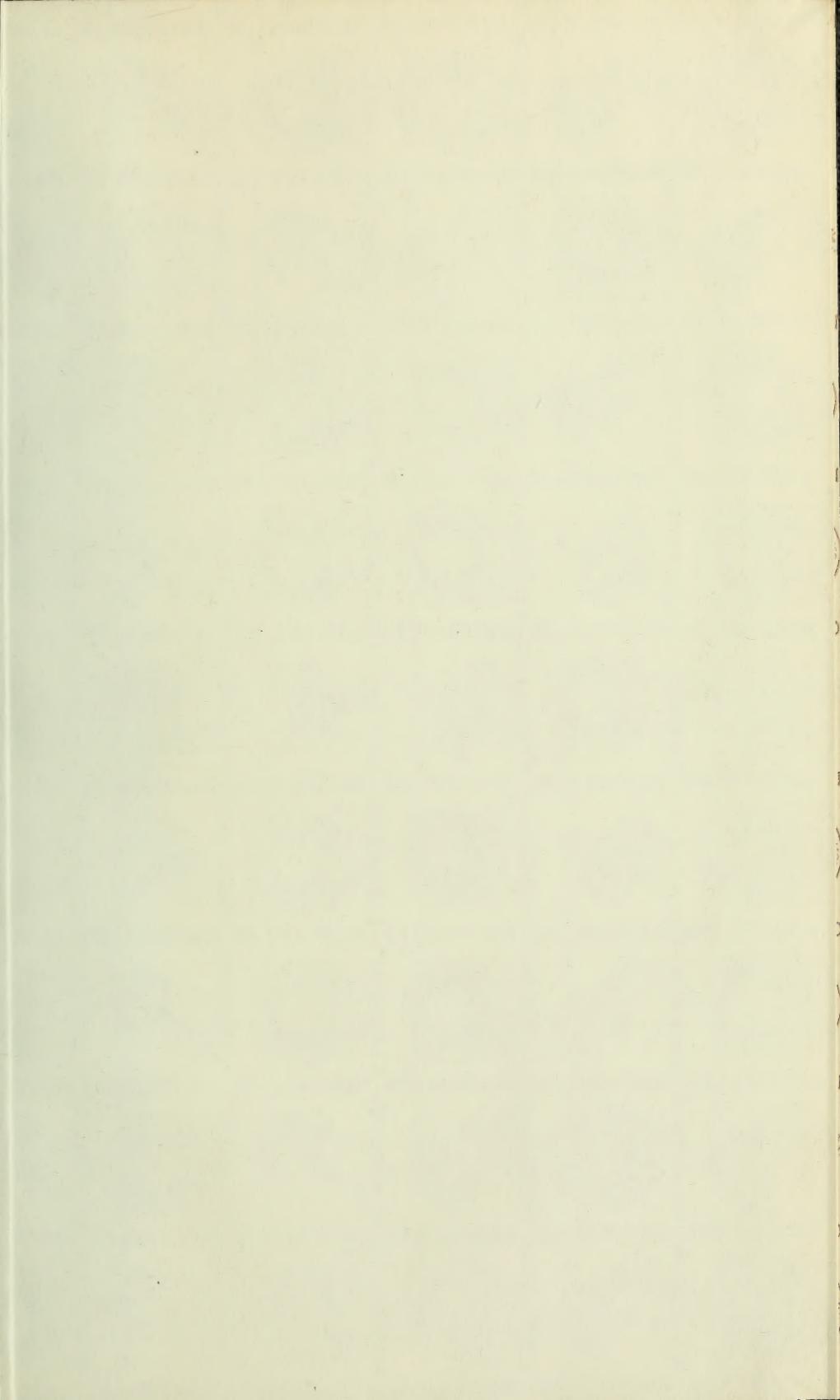
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